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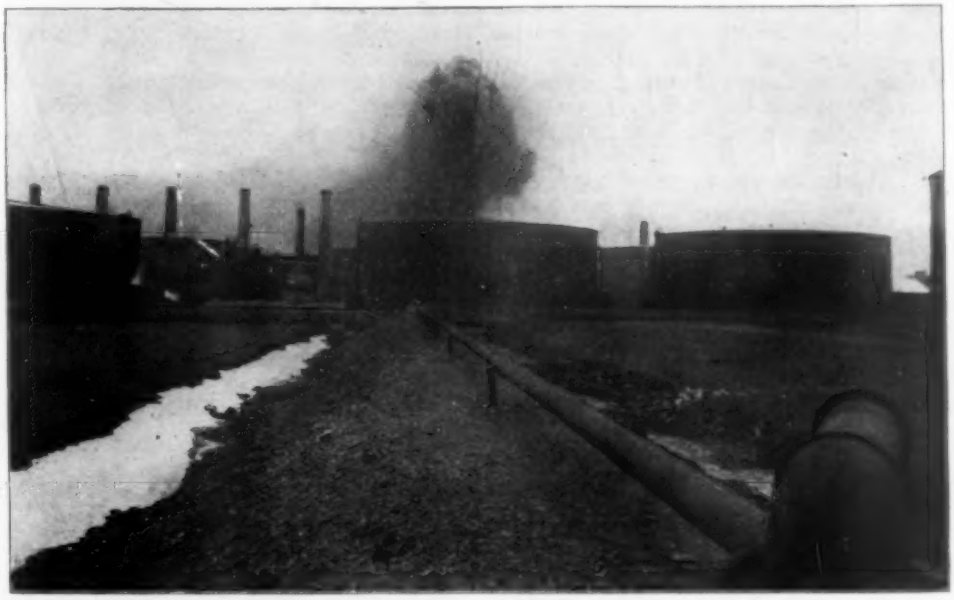
Rockefeller Will Pipe Oil Across America

Gigantic Scheme to Cost Millions that will make the Standard Oil Company Independent of Railroads, and will Revolutionize the Methods of Transportation

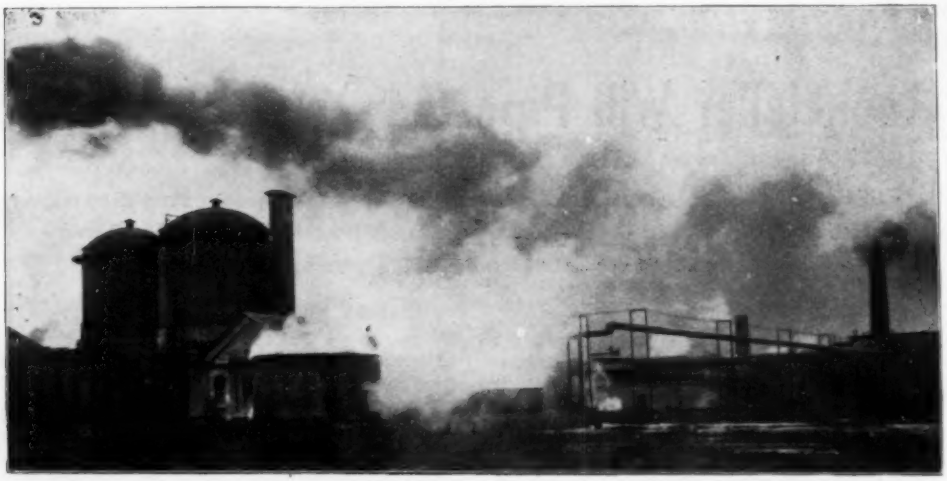
Smoke that rolls from a thousand stacks and, commingling into one dense, massive cloud, is wafted out over the lake, enshrouding water and commerce in its gloom: rows of giant iron kettles, under which furnaces burn day and night; huge storage tanks dotting the ground as far as the eye can reach; sedulous, grimy streets as black as night, a city of perpetual exertion, a city of mystery whose happenings are rarely known and whose strictest law is secrecy. This is the colossal plant of the Standard Oil Company, at Whiting, Ind., the largest oil refinery in the world, which soon is to be made of three-fold more importance through a vast scheme of developing the new southern and western oil regions.

Above and below ground is a network of pipes of flowing oil, and the Whiting plant is the heart that pumps through these iron veins the life-blood of the Rockefeller millions. The plant is to be made the radiating point of the oil industry in America. From it pipe lines are to extend in all directions, tapping every oil region in the country.



Great City of Tanks and Smokestacks at the World's Largest Oil Refinery

Handling the entire crude oil production of the East, West and South, through underground pipe lines, instead of by railroad tank cars, is contemplated in the great development plan. Streams of oil flowing under-



Scene in the Crude Oil Refinery Department

ground through connected pipe lines extending all the way from Port Arthur, Texas, through the oil regions of Oklahoma, Kansas, Indiana, Ohio and the East, to New York City, a distance of more than 2,500 miles, will be the result when the scheme materializes. From this great "trunk pipe line" branches will extend to all the Standard Oil refineries. This system of underground oil transportation will make the Standard Oil Company entirely independent of the railroads for handling crude oil. It will save the company millions of dollars annually in freight expenses and will annul the anti-rebate law so far as the Rockefeller interests are concerned, for Rockefeller will no longer have any cause for accepting rebates from railroads as none of them will be transporting his crude oils.

The Whiting plant is practically to become the central plant of a mammoth pumping system that will have streams of oil speeding underground across the continent, from the Gulf of Mexico to New York City. A visit to this great refinery, where tanks, stills, pipes, pumps and other machinery for building other refineries are now stacked up ready for shipment, is replete with interest. The plant is but 20 miles from Chicago, and though it is twice the size of the next largest oil refinery in the world—the one at Bayonne, N. J.—many people in Chicago scarcely know there is such a place in existence as Whiting, Ind. Few of the students of the University of Chicago, endowed by Rockefeller, know that over their very institution of learning rolls the smoke from a center of energy that is Rockefeller's greatest source of wealth. This is all because of the policy of secrecy that is early instilled into every person that derives his livelihood from the Standard Oil Company.

"The greatest offense an employe of the Whiting plant can commit is to talk," said an old resident of Whiting. This is certainly true, for, from no official, from the lowest paid ash carter to the vice-president, can any reliable information be obtained as to the extent or operation of the plant. No stranger is permitted to enter the works; few reports of accidents that occur here ever reach the outside world. Workmen are often carried from the shops dead and dying, but their closest friends and even their relatives may never know the cause.

The Standard Oil employes at Whiting are paid good salaries, they are treated well and may hold their positions through life by doing fair work if they will not talk, but talk they must not.

Disguised as a laborer of the Whiting plant, I, with some difficulty, succeeded in making my way through the great refinery and, with the aid of a hand camera, I took the first photographs of the Whiting plant that were ever obtained. Photographing any of the buildings or works here is

strictly prohibited. My camera was a box-shaped affair that could not be readily recognized as a picture-taking machine and was arranged so as to look more like a lunch basket. I walked straight forward without asking any questions, as though I were perfectly familiar with the establishments and the guards did not hinder me. My greatest trouble came when I wandered into a section of the plant that is malodorous with a nauseating gas that none but the inured can endure. Not knowing this I plodded on until a sickly feeling informed me that I must make my way out as speedily as possible. This I did, and with safety, but several times I thought the gas would overcome me before I could escape its terrible fumes.

This gas is said to have caused the death of a number of persons. It has a strange effect on the hair, beard and eyebrows of some of the workmen, sometimes giving to them a grassy hue. Whiting, Ind., may be said to be the only town in the world with citizens having green beards and hair.

The Whiting refinery was established in 1889, when two whole sections of land were purchased from Jacob Forsyth and Henry Scharge. It was from the beginning the Standard Company's largest plant and the world's largest refinery, and it has been added to and improved since then until its capacity is now more than doubled. At present there are more than 200 stills in which the crude oil is refined on the same principle that is employed in distilling whisky. The oil stills are immense kettles under which furnaces are kept burning. The vapor passes through coiled pipes cooled by water and is thus condensed into various oil products.

An eight-inch pipe line, reaching to the refinery from Lima, O., 200 miles, and fed by wells of the Ohio and Indiana fields en route, furnishes the present crude oil supply. There are pumping stations 50 miles apart all along this pipe line, and at each station there are about 10 men employed. The cost of transporting the oil through this pipe line is about one-tenth of what it would be if shipped by rail. The line pumps into Whiting each day an amount of oil averaging 300 cars, which is the present capacity of the plant. This

Rows of Stills as Far as the Eye Can Reach

capacity is to be greatly increased when the proposed improvements are made and when the great inter-state pipe line system is in operation.

The oil on reaching the plant through the pipe line is pumped into the immense storage tanks, of which there are 112 at the Whiting works. Each of these tanks holds 90,000 barrels of oil. The tanks are each 90 feet in diameter and 60 feet high. The oil which comes through the pipe line in excess of the consumption is stored in the tanks. The entire works, covering 1,200 acres, are connected with this 8-inch pipe line that supplies the plant. The connecting lines, of which there are a myriad, stretch in all directions above ground and under ground.

All the products that can be manufactured from crude oil are made at the Whiting plant. There is manufactured everything from naphtha and the finest illuminating oils to tar and paraffin wax, from which chewing gum and wax candles are made. It seems odd to think that chewing gum is made from kerosene oil, but even this has been accomplished through Rockefeller's exertions to convert oil into as many uses as possible.

The Whiting refinery, as well as being the center of the new pipe-line system, is the world's academy of the oil industry. Here are discovered all the new oil products; the new methods of handling and refining, and men are employed to do nothing else except devise new and improved ideas. M. W. Burton, superintendent of the plant, is one of the world's most famous expert oil chemists. He has under him a corps of experts whose sole duty is to experiment with the oil to see what can be done with it; what new products can be made from it; what new methods for handling it can be discovered. Painful and serious accidents have several times happened to the chemists, it is said, from the dangerous gases produced from the oils, but their work goes on uninterruptedly, year in and year out. The chemists have before them a miniature oil refinery containing every department of the big, real plant and experiments are made continuously with a view of improving each and every line of the work. It is due to these chemists' efforts that so many different kinds of products are now obtained from crude oil.

The first product of the still as the vapors condense are the lighter oils, such as naphtha, gasoline, etc. As the condensation proceeds on down the worm the heavier products result. They are such as ordinary kerosene, lubricating oils, fuel oils, etc. Each still is allowed to run about one week, when the fires are drawn and it is cleaned out. In the bottom of the still is a sediment that has formed, and this is called oil coke. It is the universal fuel of Whiting, Ind., little coal or wood being used by any of the residents of that city. The coke sells for $3.50 a ton. It is much lighter and goes much further than a ton of hard coal. It saved the people of Whiting and adjoining districts from suffering during the coal famine. Until a few years ago this sediment was used to fill sloughs and men were hired to haul it away.

Even after the pipe line is shut off there is a deadly gas that escapes from the stills after the fire is drawn, and numerous fatal accidents have resulted to men who have entered to remove the coke too early. Always, however, the men go down into the stills before they are cooled. They wear wooden shoes to prevent the heated sediment from burning their feet.

In making paraffin wax, one of the most important industries of the establishment, the crude oil is distilled into a dense, almost solid substance. The wax is perfectly white and not disagreeable to the taste. Tar manufacture is another important industry at the plant. There are numerous tar stills and the tar is produced by another method of distillation.

Besides the men whose duty it is to study out new products that can be obtained from oil, there is a corps of expert mechanics employed to devise means of economizing labor, of substituting machinery for hired help; and it is wonderful to note the success of their efforts. Everywhere about the plant there is the rush and roar of extreme energy and exertion, but the part the men play in the great manufactory is small. Improved machinery is doing the work; not that the employes are fewer than they ever were before, but the capacity of the plant is daily increased by new contrivances that make one man's efforts productive of greater results. In the entire Whiting plant, a veritable Colossus of modern industry, but 2,500 men are employed. The pay roll averages $140,000 a month. Shoveling coal requires the efforts of more men than any other single occupation, and it is a puzzle to the outside world to explain why the plant that handles more oil than any other plant in existence should itself burn

coal instead of fuel oil. It takes 700 men to lift the coal shovel that fires the Whiting plant, which burns 200 car loads of coal a day.

The Whiting plant is under the direct supervision of W. P. Cowan, first vice-president of the Standard Oil Company, whose office is at the western headquarters of the company, 5 Randolph street, Chicago. It is Mr. Cowan who is at the head of all the vast improvements the company now has in contemplation in the West.

Outside of the packing houses there is probably no industry subsidiary to Chicago of half such consequence as the oil refinery at Whiting. The value of the plant, as estimated by city officials, and real estate men of Whiting and other parts of Indiana, is $35,000,000. The company pays taxes on $3,000,000 of property. The plant is the only source of revenue of the town of Whiting, which has a population of 6,000. The Whiting plant is dotted with enormous smokestacks, and an idea of the value of the establishment might be obtained when it is stated that these smokestacks cost $5,000 each to erect. The stacks reach 100 feet in air and from them rolls the smoke which from the lake gives the plant the appearance of a dense, black cloud enshrouding the water.

While the Whiting plant is at present fed from the Ohio and Indiana fields, it is believed that this arrangement is to be changed and that the new Kansas oil fields are soon to supply this greatest of the world's refineries. In that event the Ohio and Indiana oil will be used to supply the eastern refineries, and the Kansas City refinery, that is soon to be built, at present to refine Kansas oil, will in time obtain its crude oil supply through pipe lines tapping the Oklahoma and Indian territory fields and possibly the Texas fields.

Streets of Grime as Black as Night

The anti-rebate law is indirectly responsible for the establishment of the mammoth pipe line system that threatens in time to reach from ocean to ocean across the United States. The law was aimed at the Standard Oil practices which so effectively restricted competition a few years ago.

Since 1902 the United States has led the world in the production of petroleum and the output is still increasing by the constant opening up of new fields. Russia, the nearest competitor to the United States, in its last report shows a decline. In 1902 the United States produced 48 per cent of the

entire petroleum output of the world and the figures doubtless will be greatly increased when the report of 1903 is issued. In 1902 the United States produced 88,377,722 barrels, which was 8,266,862 barrels more than Russia and 19,377,722 barrels more than the preceding year's production of the United States. Russia's production showed a decline of 4,628,512 from the preceding year.

For this increase the United States is indebted to the West and South. But for them the output would have fallen far below that of Russia and in fact would have shown a decrease compared with the production of 1901. All the old eastern oil fields which have heretofore been the principal source of the Rockefeller millions and of the big American oil production show a falling off. The great Appalachian field, whose supply was once declared inexhaustible, fell off 2,599,384 barrels, or 4.76 per cent. This, too, after there had been sunk in this field 1,562 more wells than were opened in the previous year, in a desperate but vain effort to retain its regular output.

Pennsylvania showed a decrease of 4.45 per cent; New York of 7.20 per cent; Ohio, 2.93 per cent; West Virginia, 4.68 per cent, and Illinois, 20 per cent. Texas showed an increase of 311 per cent; California, 59 per cent; Kansas, 85 per cent; Indiana, 30 per cent; Indian Territory, 270 per cent, and Kentucky and Tennessee, 35 per cent.

These figures tell volumes. They would indicate that the United States is destined to supply the world with oil and that the supply must come from the West and South. The eastern United States fields and the Russian fields are falling off and the western and southern United States fields are increasing in enormous proportions. Besides this, new western and southern fields are being constantly discovered. Alaska is regarded as an important field for prospecting at present.

The Standard Oil Company, therefore, has recognized the coming great importance of the new oil fields as the future source of supply and has taken steps toward their development to a high degree. For this purpose the vast improvements are to be made at a cost of probably $200,000,000. The immediate improvements, besides the numerous pipe line constructions, include the erection of a big refinery at Kansas City, the employment of a fleet of oil steamers on the Great Lakes, and the construction of ports specially for the docking of the oil steamers. Five of these oil steamers are already built and will be placed in commission this season. A pipe line will at once be built to carry oil from Neodesha, Kan., where there is a small refinery now located. Pipe lines already branch out to different sections of the Kansas fields. The Kansas City plant will contain 30 stills for refining oil and there will be an acid plant, paraffin works, candle works, and facilities for the manufacture of all kinds of illuminating and lubricating oils, gasoline, axle grease, tar, etc. The plant will comprise 120 acres.

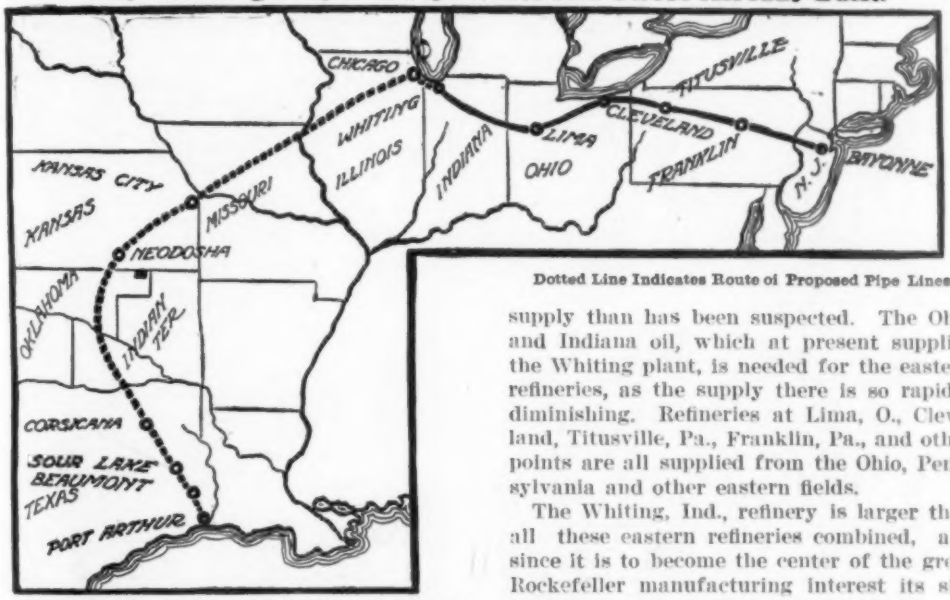
Distilling Kettles as Seen From a Distance

A pipe line is planned to run from Whiting to Neodesha, Kan., which will then give a continuous line from Kansas City to Chicago and thence to Lima, O. By this time pipe lines will have been built east from Lima to Bayonne, N. J., where the second largest refinery in America is located. Bayonne is just across the bay from New York and is connected by pipe lines with all the great eastern oil fields. The next step in the gigantic plan will be the building of a pipe line from the Beaumont oil fields to Kansas City. This will complete the chain of pipe lines from the Gulf of Mexico to the Atlantic ocean and from them branches will extend to every oil district in the South, West and East.

The mammoth scheme of developing the Kansas oil fields, shows that the Standard company expects more from that source of supply than has been suspected. The Ohio and Indiana oil, which at present supplies the Whiting plant, is needed for the eastern refineries, as the supply there is so rapidly diminishing. Refineries at Lima, O., Cleveland, Titusville, Pa., Franklin, Pa., and other points are all supplied from the Ohio, Pennsylvania and other eastern fields.

The Whiting, Ind., refinery is larger than all these eastern refineries combined, and since it is to become the center of the great Rockefeller manufacturing interest its size and importance will be greatly increased. The Whiting plant is to become what might be termed the capital of the oil world.

Map Showing Proposed Pipe Lines and Those Already Built.

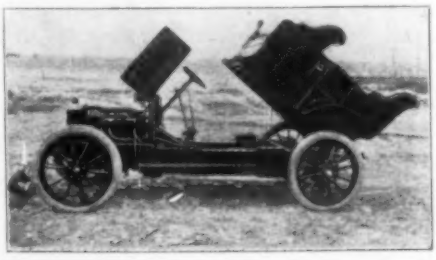


Dotted Line Indicates Route of Proposed Pipe Lines

CONVENIENTLY BUILT AUTOMOBILE.

New Paris Type Has a Body That Can be Tipped Up For Repairs

An oddly built automobile, which has made its appearance in Paris, may suggest a new method of constructing these vehicles. The machine is known as the Martini type and is so built that its body can be lifted up to give easy access to all parts of the machinery for speedy repairs. This should prove a great convenience in case of accident on the road. The car illustrated is the one in which Capt. H. H. P. Deasy drove up the mountain railway to the summit of the Rochers de Naye. It has 20 horsepower and is of the same type as the vehicle that won the gold medal in the European 1000-mile reliability trials. It is placed on a section of the cog-wheel track set at an angle equivalent to the average gradient that had to be negotiated. The drive on the top speed of the four forward ones is direct. Ball bearings are employed throughout the mechanism.



Martini-Built Automobile with Body Tipped

"Water Curtain," a Perfect Theatre Protection

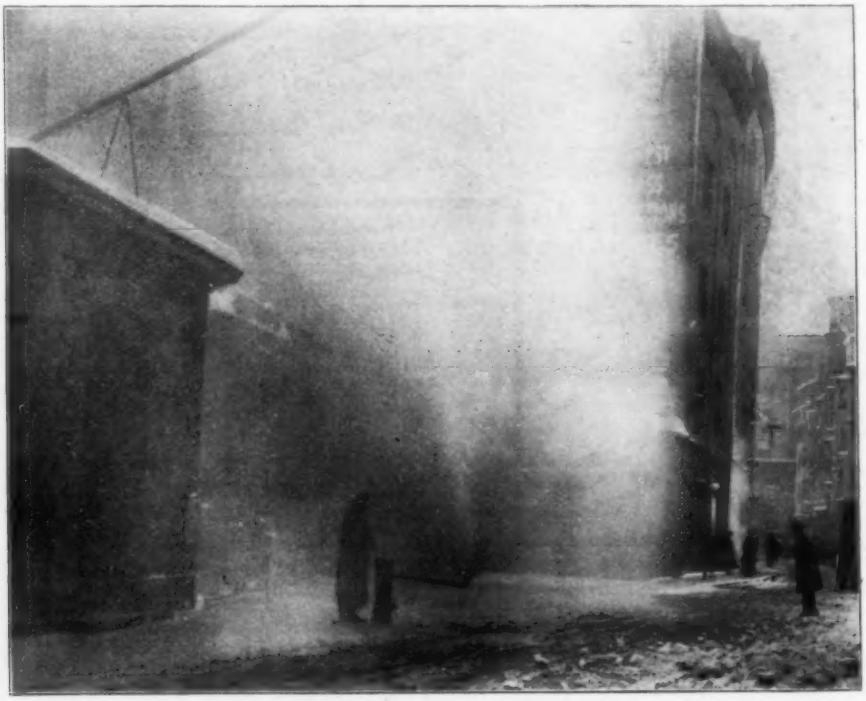
It Completely Covers the Proscenium Arch With a Liquid Wall

Solid sheets of water rising from the footlights and stretching across the proscenium arch, forming a wall of water completely separating the stage from the auditorium—this may be the fire curtain of the future. The "water curtain," which will doubtless be installed in all first-class play houses of the future, is the invention of John W. Regan, late chief of the Boston fire department, and is called the "Regan."

A pipe leads from a main in the street underneath the stage to the centre of the proscenium arch. The nozzle is screwed on to it flush with the top of the stage floor. If there is not pressure enough from the street, which should be at least 60 lbs., it must be supplied from a tank from above.

This will give three sheets of water 150 feet wide and 60 feet high. Of course there is the double action of the water going up and coming down. One of these curtains will protect the Boston theatre stage which is the largest stage in the world. The water curtain will also lift the smoke so that the auditorium will be clear and the audience can walk right out. Such a curtain might have prevented the Iroquois disaster.

The curtain of water is produced by a peculiarly shaped nozzle attached to a piece of pipe with an elbow extending upward. Across the nozzle are three slots, each about a quarter of an inch wide and extending from side to side. The top of the nozzle is not unlike a two-wick burner of a kerosene lamp. The nozzle, however, has three slots and from them water radiates in three separate sheets making a water curtain three layers thick forming a barrier absolutely impervious to flame.



Water Curtain Three Layers Thick and 100 Feet Wide as Tested on the Streets of Boston

The illustration shows the "water curtain" in a test exhibition on the streets of Boston. It will be noticed that the water flares out like a great fan, 50 feet high and 100 feet wide. Not only for theatre curtains, but for the interior and exterior of buildings is the invention designed.

Terrible Tragedy of the Submarine "A1."

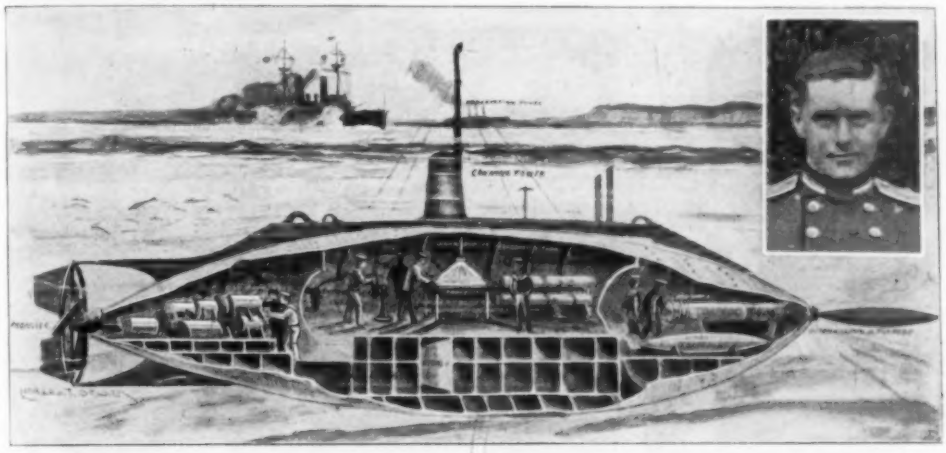
A True Story of the Loss of a Gallant Craft and Crew at the Recent Maneuvers in England

England has furnished to the navies of the world this terrible lesson on the necessity of improved periscopes enabling submarines to better see their way under water:

CHAPTER I.

Of the 29 submarine torpedo boats possessed by the British government, the "A1" as her name might imply, was the pride of that fleet of little under-water maneuverers. She was manned by the pride crew of British sub-aquatic navigators and all England was proud of her. There was a week of maneuvers at Portsmouth participated in by many splendid vessels of many kinds and witnessed by England's royalty. The "A1" was the most picturesque figure of these maneuvers. To show his appreciation of the agile little submarine and her daring crew his Royal Highness, the Prince of Wales, boarded her in person and complimented the commander. As handsome as he was daring was Lieutenant Mansergh, who commanded the "A1". He was assisted by Sub-Lieutenant John Churchill of noble British descent, and by a crew of nine petty officers and seamen as brave as ever rode with a boat above or beneath the waves.

The "A1" was the latest and most powerful of the British submarines. When submerged she displaced 180 tons. She was 100 feet long and 10 feet diameter with a tall conning tower plated with 4-inch steel, and a platform deck for the use of the crew when running awash. She was propelled by one screw, which was driven by a gasoline engine when running on the surface. In this trim she is reported to have made 15 knots an hour, which would make her the fastest submarine in the world. Under water she used an electric motor, supplied with current from storage batteries and capable of taking her 32 miles at the rate of eight knots. The hull of the boat was of steel from one-half to a quarter of an inch thick, supported by strong framing and further stiffened by bulkheads, which divided her into compartments. She had one torpedo tube in her bow, differing in this from all other subsequent submarines, which have two tubes. She carried 850 gallons of gasoline and a large quantity of air compressed in steel flasks under a pressure of 2,000 pounds to the square inch. She dived porpoise-fashion; that is, she did not sink by admitting water ballast, but by setting her horizontal rudder downwards, when her movement in the water made her take a "header." Of course, as a preliminary her trim was adjusted so as to offer very little resistance or buoyancy. To regain the surface she set her horizontal rudders upwards or in an



Sectional View Showing Interior of the "A1."--The Upper Right-Hand Corner Cut is of Her Gallant Commander Lieutenant Mansergh

emergency could expel water ballast from her ballast tanks. With this equipment the "A1" excelled all her rivals in quick movements and her wondrous work won applause at every turn.

CHAPTER II.

It was the last day of the week's maneuvers, at Portsmouth—Friday, March 18—and every day the "A1" had distinguished herself. In the afternoon all the submarines were close in shore giving many and varied demonstrations of their prowess. The "A1" was seen to submerge herself and her periscope was seen protruding above the surface of the sea. The "Berwick Castle" a passenger liner on her way from Southampton to Hamburg passed in their midst while the little boats were darting in and out of the water. The Berwick Castle called out through megaphone to the umpire's yacht, "Fire Queen," that she had been struck by something. Little attention was paid to this, however, and the manuevers went on. Two hours later the time for the closing of the day's program arrived and the signal was given for the submarines to return to Spithead. Two of the submarines, including the "A1", failed to appear at the appointed time. An hour passed and one of the missing vessels arrived, but it was not the "A1". Another hour and still England's finest submarine was missing. Glasses scanned the water and searchers were sent out but no tidings of the boat were obtained.

CHAPTER III.

Elated over her achievements and the high compliment that had been paid her by the Prince of Wales, a couple of days before, the gallant crew of the "A1" had decided to close the week's maneuvers with another brilliant feat. She submerged herself off the Nab Lightship and waited for the "bully" of the attacking cruisers to pass when she intended to torpedo the vessel that had successfully defied so many attempts before. As she was waiting the great passenger liner, the "Berwick Castle", came up at high speed from a different quarter.

Steering The Submarine by Means of the Periscope

The day was dark and hazy and because of the imperfect view afforded by the best periscopes, the officers were unable to see the approaching ship. The great liner passed directly over the little submarine tearing off the top of her conning tower. There was a moment of awful consternation as the water came rushing in from above on the officers and crew. There was no escape. The curved iron walls of the vessel hemmed them in on every side. A sea of water was overhead; the ocean's bed below. No air—only water; it strangled them. The boat was filled, and in their struggles with death they felt the gallant "A1" diving deeper than she had ever dived

Watching the Monometers While Running Submerged

before. She was going to the bottom. On down she went and settled on the floor of the sea forming a sepulchre for the remains of the gallant officers and crew—like an ocean's magic coffin, which in punishment of the men who had dared stray beyond the natural elements of man, had entombed them alive and borne them dying and dead to the ocean's graveyard.

CHAPTER IV.

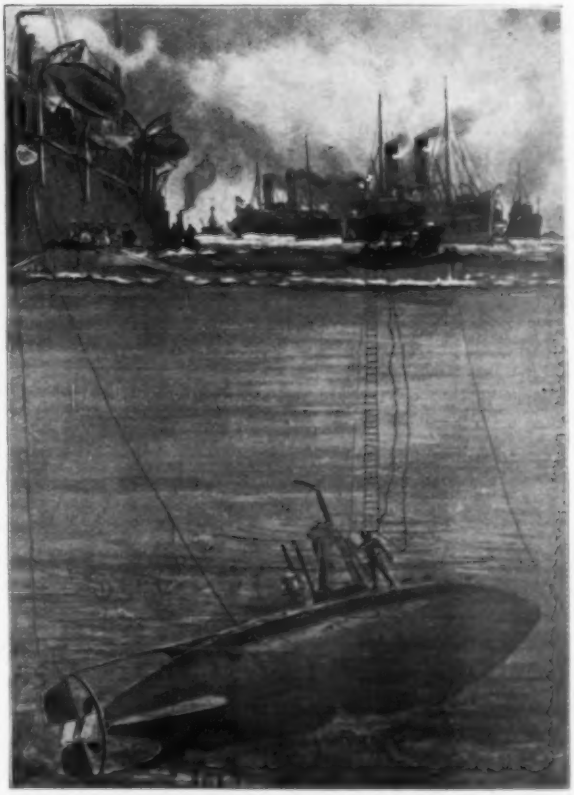
Saturday morning came and all at Portsmouth harbor were in anxiety over the missing submarine. Some one recalled the fact that the liner "Berwick Castle," had signalled the umpire's yacht on the day before that she had been struck by something. All then said that this must have caused the sinking of the "A1." Divers were sent down and sure enough there lay the submarine with all her officers and crew but one man dead inside.

Then began the work of clearing the vessel of water by pumping in compressed air. That same day the following telegram was received from the Prince of Wales:

"The Princess and I are deeply shocked to hear of the terrible disaster to Submarine 'A1' and the loss of her whole crew. We grieve to think of the relatives of those who are gone, and we feel deeply for you in this sad catastrophe.—George."

THE LESSON.

Even when the conning tower of a submarine is above water, the periscope affords the only means its occupants have of determining what is happening on the surface of the water above. This periscope, as at present constructed, does not cover the whole horizon, but only a small section of it, so that if the officer in charge was intently watching one quarter of the horizon, a ship might come up quickly from another quarter without his ever seeing it. Probably the officer in charge of the "A1" saw nothing whatever of the "Berwick Castle," or if he did see her, it was too late. An improved periscope, enabling a wide range of vision, would have prevented the awful disaster to the "A1." The improvement must be made before the submarine can be called a success.



Fishing the "A1" From the Bottom of the Sea, Showing the Exact Position in which the Boat was Found.--The Size of the Submarine is Exaggerated in Order to Secure a Pictorial Quality.

Popular Mechanics

A MONTHLY MAGAZINE

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HOW THE ADMIRAL CONTROLS THE SHIP.

The modern admiral controls the whole working of his ship from the small bomb-proof chamber known as the conning-tower. He has the steersman at his elbow and on the right and left of the wheel stand the "telegraphs" which communicate to the engine room the orders: "Full steam ahead," "Full steam astern," "Half steam ahead, or astern," "Dead slow," "Stand by," and "Stop." There is communication by speaking tubes and electric bells with every part of the ship, and each gun may be said to be practically fired by the admiral. The positions of Admiral Togo and his officers, shown in the illustration, are from a Japanese picture, but the details of the arrangement of the conning tower were supplied by a naval expert.

Admiral Togo on His Flag Ship

"DANGER SIGNALS" FOR SUBMARINES.

The terrible disaster to the Submarine "A1" as described elsewhere in this issue, besides showing the need of an improved periscope, shows the necessity of some method of giving a distress signal when a submarine has met with accident. The "A1" went down while battleships and boats of all kinds were all around her. Evidence indicates that a man of the "A1's" crew had been fired out of a torpedo tube while she was sinking, in the hope that he would be able to reach the surface of the water and give the signal that the others had gone to the bottom. The body of the man, believed to have been fired from the torpedo tube, was not found in the boat with the other members of the crew. Of course this method of signaling, used as a last resort, failed absolutely.

Torpedo boats should be provided with some kind of float attached to the boat which could be cut loose in an emergency and which would at once rise to the top and there, coming in contact with the air, explode and emit a light as a distress signal. Some contrivance like a "Holmes light" would doubtless answer the purpose. This light is used in running torpedoes for exercise and might well be adapted to torpedo boats. The light consists of an arrow-headed tin canister pierced with several holes and filled with phosphide of calcium. The action of water on the chemical causes a rush of bubbles to fly to the surface of the water, where, on mixing with the oxygen of the air, they burst into flame and give out an enormous amount of garlic-smelling smoke.

At present the man who goes down in a torpedo boat takes his life in his own hands.

The Great Trans-Siberian Railroad

The World's Longest Line of 5,400 Miles Built by Russia at a Cost of $200,000,000

Stretching 5,400 miles from Moscow to Port Arthur, the Trans-Siberian railroad connects the heart of Russia with its far eastern possessions and is the longest, costliest and most remarkable railroad ever built. In the 5,400 miles of its distance from Moscow to Port Arthur, there are 100 miles of bridges, some of which span streams more than a mile wide and are imbedded in treacherous, shifting sands.

At Harbin, in Manchuria, the road divides, one line extending east to Vladivostock and the other south to Port Arthur. The longest run is from Moscow to Port Arthur. That part of the road in Chinese territory, about 1,600 miles, is called the Chinese Eastern railway. What is known as the Trans-Siberian railroad, proper, extends from Moscow to Irkutsk, Siberia, which is 43 miles west of Lake Baikal, and is 3,672 miles from Moscow.

The Chinese Eastern railway is but another name for that part of the Trans-Siberian railway east of Lake Baikal, just as the Texas line of the Rock Island road is called the Chicago, Rock Island and Texas, instead of the Chicago, Rock Island and Pacific. The concession for the construction of this section was granted by China in return for Russian diplomatic and financial help in settling the issues arising out of the war between China and Japan. From Nikolskoe, near Vladivostock, a branch line called the Ussuri railway extends north 375 miles to Khabaroosk, on the Amur river.

Like all the Russian railways, the Trans-Siberian was built and is operated by the Russian government. The first tie was laid at the Pacific terminal of Vladivostock, May 12, 1891, by the present Czar, Nicholas II., who was then Czarowitz.

Military Trains Crossing Lake Baikal on Rails Laid on the Ice

Preliminary work on the line began early in the 70's. The great bridge over the Volga was completed in 1880.

Noted throughout Russia are the famous trains de luxe, which leave Moscow once a week. This is the finest and fastest train on the Trans-Siberian road. It makes its run to Valdivostock in 18 days. At Harbin the through cars for Port Arthur are cut off and reach their destination two days later. Port Arthur is 210 miles further from Harbin. To show the superiority of American traffic, it should be remembered that the run from

New York to San Francisco, 3,250 miles, is accomplished in four days and ten hours. Slower passenger trains on the Trans-Siberian require a month to make the trip, and freight trains two months. All the railroads

Map Showing the Route and Three Different Divisions of The Trans-Siberian Railway

of Russia, of which there are 25,000 miles, have a 5-foot gauge, which being different from that of any other country, makes it impossible for any alien rolling stock to be used on this or any other line of the Czar's domain. The standard gauge of all other continental railroads is 4 feet 8½ inches.

More than $200,000,000 was required to

Russian Military Railway Across An Ice-Bound River

build the road and the cost will be increased by $20,000,000 when the line around Lake Baikal is completed. Lake Baikal is the mysterious Holy Sea of Siberia and furnishes the only break in the entire distance of the line from Moscow to the Pacific coast. This is the only body of fresh water in the world that is inhabited by seals. It is the deepest body of fresh water in the world, reaching the enormous depth of 5,000 feet. The lake's level is 1,500 feet above the sea level, while its bottom is 3,800 feet below the sea level. Lofty mountains wall it in on every side and the rocky shores are seamed by innumerable torrents that have to be bridged. The lake has an area of nearly 15,000 square miles. It is 500 miles long and is 42 miles wide at the point where it is crossed by the Trans-Siberian railroad ferry. An ice-breaking ferry boat, the largest in the world, built at a cost of $4,500,000, is operated across the lake in winter.

Henry C. Rouse, president of the Missouri, Kansas & Texas railroad, who made a trip over the Trans-Siberian a short time ago, says:

"The Trans-Siberian road is today in about the same condition for actual service as was the Northern Pacific railroad a few years before I became receiver of it. It was built by methods akin to those by which our great transcontinental roads were built.

"The bridges, with the exception of those on the old road in level country west of Samara, are up to the requirement of the modern American motive power. Some of the track now in use on the greater part of the Trans-Siberian line, especially on the east end, is still laid with 56-pound rail, which is rapidly being relaid with 65-pound rail. Much of the track is still unballasted and

some of it is not even properly surfaced in Manchuria, where, however, the ties are the worst feature of the work, few and far between, and many of them round on top, having not more than a 4-inch face, being made by splitting a pine log in two, laying the flat face to the ground and adzing off the spot to receive the rail on the round side.

"To all appearances the road is well located with good alignment and slight curvature and modern grades, save on the Ural mountain division, where the trains reach an altitude of 3,600 feet, about half that attained by the trains on crossing the Great Divide of the United States. Sidings have been built at intervals of 12 or 15 miles along the line.

Train Approaching Lake Baikal

"Much has been said of the Trans-Siberian railway's inefficiency on account of its being a single-track line, but the fact is seemingly overlooked in this criticism of the Trans-Siberian system that the great trunk lines of America are mostly single track west of Pittsburg and that barely seven per cent of all the main line mileage in the United States is double tracked.

"The efficiency of the entire Trans-Siberian road depends on its efficiency to transport passengers and merchandise across Lake Baikal.

"The railway now being built around the lake involves much more tunneling and other heavy work. Such a lake shore line will do much toward bringing the road up to the efficiency of some of our own transcontinental systems."

The Trans-Siberian road connects the Ural frontier with the lines of European Russia and now affords unbroken railway communication between the Pacific coast and the capitals of Europe. The road was built entirely by Russian engineers, though many of the rails and some of the rolling stock came from the United States. The rapidity of construction of the Canadian Pacific railway, averaging 300 miles annually for 10 years, is often cited as marvelous; but of this Russian line 5,166 miles were built in 10½ years, or at the rate of nearly 500 miles a year. Moreover, a change of plan to secure a firmer roadbed and safer and more adequate service necessitated reconstruction after a considerable portion of the line had been completed.

When the section around Lake Baikal is finished, the time of passage from St. Petersburg to Port Arthur or Vladivostock will be reduced to about 12 days.

The railway stations along the Trans-Siberian are, as a rule, superior to those of the rural districts of the United States. No two of them are exactly alike in style. At every station the government has built a church; even at the smallest depots, where the place of worship is 10 by 12 feet.

Bridges along the route are built of steel and substantial masonry and their construction is especially commendable. The bridge over the Irtish at Omsk is one of the finest in the world. With its approaches it is nearly four miles long and has an opening of 2,100 feet. A bridge 3,000 feet long spans the Yenisei, the grandest river of Siberia. The Amur river at Khabarovka is crossed by a bridge nearly 5,100 feet long. Forty-six bridges, none less than 200 feet long, cross tributaries of the Obi river between

Immigrant Car on the Trans-Siberian

Fourth Class Cars on the Trans-Siberian Railway

Irkutsk and Lake Baikal, a distance of only 41 miles.

For 600 miles the western section of the road runs through a splendid farming country, producing an abundance of grains of all kinds; 300 miles is through a well-watered grazing district, and for 200 miles east of the Obi the surface of the country, though broken by hills, is heavily-timbered and well-drained. The central division, between Tomsk and Irkutsk, traverses on the whole a barren upland of unknown mineral possibilities, but whose climate and soil forbid settlement. East of Lake Baikal the road rises gradually to the crest of the Yablonoi mountains, there reaching its highest elevation, 3,412 feet, and thence descending the Pacific slope to the valley of the Amur.

Alfred S. Johnson, Ph. D., says: "This trans-Baikalian section traverses one of the wildest and most romantic tracts ever penetrated by railroad engineers, a section of untold wealth in gold, silver, copper and iron, which is already attracting a rapidly growing population. The Amur division, as projected, has its route for about 1,600 miles through a well-timbered alluvial land, enjoying a climate tempered by proximity to the Pacific; while the Ussuri section, extending up the valley of the river of that name, from its junction with the Amur at the point where the latter turns abruptly northward on its final rush to the sea, runs through a hilly country, well adapted to agriculture and stock-raising and rich in bituminous coal."

Flat Cars Carry War Vehicles

Both the branches through Manchuria tap a rich and thickly settled farming country.

The road crosses the four great rivers, the Obi, Yenisei, Lena and Amur, over their upper waters at about the point where they begin to be easily navigable, thus facilitating communication throughout the entire length of their valleys. This is of special importance in aiding the movement of cereals, which comprise one-half the total exports of Siberia. The annual grain crop amounts to about 4,000,000 tons.

The Technical World says: "The facilities of communication offered by the road will also stimulate development of the arable plains and the cattle-breeding districts of the Steppes now roamed by the Kirgiz race, the finest of the Tartars. For Siberia has the largest grazing reaches in the world and is the original home of the whole granivorous stock."

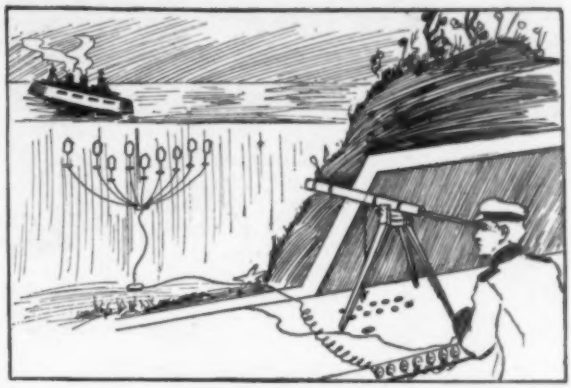
Last year the Trans-Siberian road carried 1,000,000 tons of freight and in all 1,300,000 passengers. The locomotives, while in good operating condition, are for the most part wood-burning and of the type in common use in this country during the '80's. Passenger accommodations are divided into first, second, third or fourth class. A fourth-class car will accommodate 12 cattle or 40 persons, and is used interchangeably.

Popular Mechanics is the first mechanical publication in the world to publish records and descriptions of mechanical events and constructions so that anyone, whether he be a mechanical student or not, can comprehend their meaning. There are innumerable mechanical journals published, but just one "written so you can understand it." To demonstrate the demand for such a publication you have but to read the first line on the front cover of Popular Mechanics which says: "Largest Circulation of any Mechanical Publication in the World."

Under-Water Terrors of Modern Warfare

Submarine Mine the Most Dreaded of All Death-Dealing Devices--How They Are Constructed and Operated

Seated in his little underground room beneath a clump of bushes the operator of submarine mines, himself secure from danger, looks out through a peep-hole and watches the enemy's ships approach the harbor; he scans his diagram of the water; he notes the position of the ships and, sure of the location, he begins to press the buttons on the table before him. Every time he presses a button a ship is probably tossed up in a great wall of water and blown to destruction.



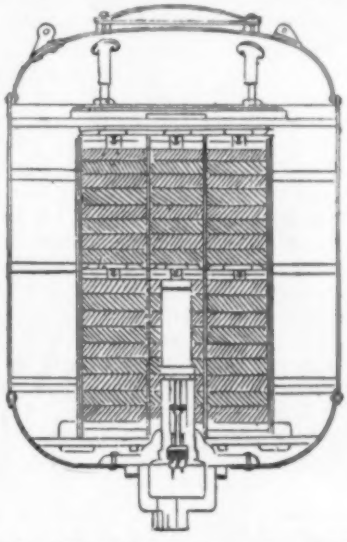
Operator Manipulating Observation Mines From His Underground Room

The diagram before the operator indicates the location of hidden submarine mines guarding the harbor. Each line of mines is connected by electric wires with the table before the operator. The mere pressing of a key discharges a line of probably six mines and it is the operator's duty to discharge a line of mines every time a ship chances to be within the mine's destructive range.

The operator's underground room or cave is on shore overlooking the harbor. It is so located that the occupant can have a clear view of the mine field without being seen himself. The cave is just large enough to permit him to be seated comfortably and to have easy access to his firing battery and key. If possible, the observation station is hidden with bushes, vines or other vegetation that will not attract the enemy's attention. If in barren ground the peep hole is made very small and any wood about the construction is painted as near as possible the color of the surrounding soil.

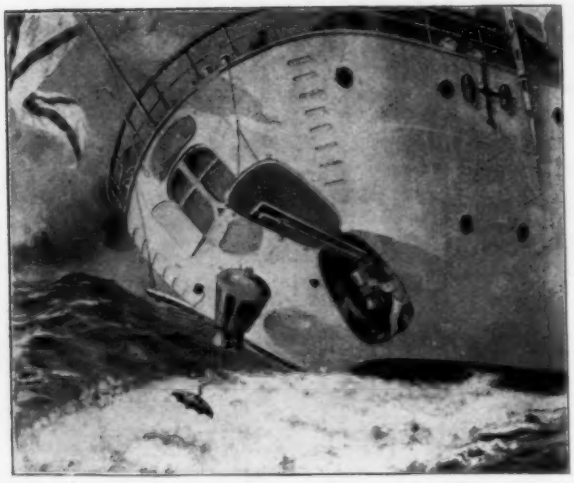
This particular kind of mine that is discharged by the operator is known as the "observation mine," so called because it is worked by the observations from shore. There are other kinds of mines that are not discharged until they are actually touched by the bottom of the ship. These are known as "electro-contact mines" and "electro-mechanical mines."

Submarine mines are very dangerous things to handle and, unless the utmost caution is exercised, they may be of more destruction to the ships of the country they are supposed to protect than to the enemy. Such has been the case at Port Arthur and Dalny where several of the Russian vessels are said to have met destruction by mines the Russians had planted to guard the harbors. The Russian mine-transport "Yenesei" was employed especially to lay mines. The mines used by the Russians are known as



Showing Construction of an Observation Mine

"Malinorowski" mines and are the same as the American and English "electro-mechanical" mines, which are self-operating. One of the illustrations shows the ill-fated vessel



Russian Transport "Yenesei" Laying Mines

engaged in the work of laying the mines. The method was as follows: When the port was opened a spar shaped like a T-girder was made to project from it. Along the narrower part of the spar ran a sliding hook to which the mine was attached and drawn out until it overhung the water. At the proper moment a cord was pulled which released the mine and let it fall into the water. The mine then moored itself automatically, as shown in the illustration on the opposite page. When the case M, containing the charge had sunk to a certain depth, it received some support from the float b, and thereupon the anchor A began to unwind itself from the drum D until it found its hold in the sea-floor. The mine would keep a uniform depth below the surface and would rise and fall with the tide. The moment a passing ship struck any of the passing studs t t t the mine would explode. One of the mines thus laid by the "Yenesei" at Dalny was struck by that vessel and the "Yenesei" was destroyed.

Mines, like many other of war's deadliest devices, had their birth during the struggle between the north and south in the American War of the Rebellion.

The Royal Navy Handbook of England says: "Both torpedoes and mines came into existence during the progress of the American War of Secession, when no fewer than 28 vessels were blown up by mines and six vessels by various forms of torpedoes. Their remarkable success set a good many clever heads thinking and it was in 1864, only two years later, that the original idea of the torpedo was evolved from the brain of an officer of the Austrian army."

In those days, however, the use of electricity was little understood, or that great force, which also owes its adaptation to America, would have rendered the mines a hundred times more deadly. The explosives then were also comparatively inferior. Commander Charles Napier Robinson of the British Royal Navy in a work on submarine mines, says: "In the American War of Secession, when so many vessels were sent to the bottom by torpedoes, the mines were more often than not of the most makeshift description. Wooden barrels made water-tight filled with gunpowder, and fired by hauling-lines or slow-burning fuses, were the usual instruments whereby the Confederates conducted their subaqueous attacks on their opponents; for electricity and its application to submarine warfare was then only very imperfectly understood. Yet nearly 30 vessels were sunk by these means, thereby clearly proving that mines have not necessarily to be of delicate construction to be efficient. On the other hand it may perhaps be taken for granted that, for every mine which accomplished the work for which it was intended, dozens of others failed ignominiously, as for instance in the case when Admiral Farragut brought his fleet safely over the mine-field which should, if it had been in an efficient condition, have utterly destroyed him. Yet even at the present time our seamen are taught how to carefully prepare extemporé mines from the crudest materials and there is little doubt that, provided proper care and intelligence are displayed in their preparation, they will prove nearly as effective and reliable as the modern up-to-date submarine weapon."

Admiral Farragut's achievement, alluded to by the English writer, was at Mobile, where the harbor was known to be alive with mines. The admiral was warned against entering. Already one of his ships, the "Tecumseh," had been sunk by one of the hidden explosives and the admiral again was told to turn back and beware of the mines. "Damn the mines," said Admiral Farragut and he steered the whole fleet into the harbor. The cases of the torpedoes were heard by many on board knocking against the copper sheeting of the bottom and many of the primers snapped audibly,

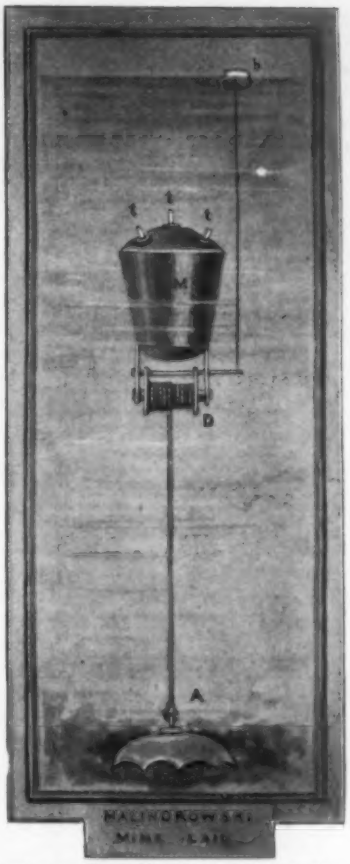
but no torpedo exploded. It happened that the mines were all defective, otherwise the admiral's fleet would have met certain destruction. He knew this, but his fleet was in a state of utter confusion and to recede was as dangerous as facing the mines. Victory rewarded his daring.

"Although the admiral successfully defied the mine field," says an English writer, "probably no man has ever lived who has so thoroughly experienced the moral power of one."

Mines are dreaded far more than guns by an attacking fleet. It was the mines at Port Arthur that kept the Japanese from capturing that city when it was otherwise almost defenseless. An opposing fleet might easily bring itself to attack a flotilla of torpedo vessels, but it would hesitate very considerably before risking its vitals over a mine field.

One of the best evidences of the moral power of the mines is furnished in an instance of the Franco-Prussian war when the French fleet was prevented from entering Prussian harbors simply through fear of submarine dangers.

An explosive more deadly than dynamite, nitro-glycerine or guncotton is now used in the mines manufactured to defend American harbors. The explosive is called "maxemite." Loaded with it the explosion of a 72-pound mine is certain destruction to any ship that floats. These are for emergency use, however, and the usual form of observation mine manufactured in the United States and Great Britain is loaded with 500 pounds of guncotton. The observation mine consists of a cylindrical case of steel plate 3/16-inch thick, 32.2 inches in diameter, and 34 inches deep with its ends rounded. Eyebolts are riveted on the top and bottom for handling and anchoring. Access to the inside of the mine is given from both ends. The mine charge is packed in 22 copper cases stowed in two tiers, each case being fitted with rewetting holes; the center copper case has a hole in it for the reception of a primer tip, which is used for the purpose of exploding the wet guncotton and consists of a tin filled with disks of dry guncotton with detonators fitted into them. The wires leading into the mine pass through what is called an "insulating plug" fitted in the mouthpiece of the mine. This plug is kept ready-fitted for insertion into the mouthpiece of the mine and has two 3-foot wires rove through it, the nut being placed at a distance



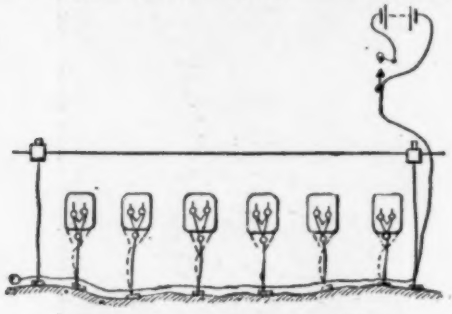
Automatically-Moored Mine

of eight inches from one end of them. By means of "puddings" on the wires, gland nuts and leather washers, the insulating plug is kept absolutely watertight in the mouthpiece. The insulating plug is a most important part of the mine's construction and is, therefore, always carefully tested.

In fitting the mine for service, the dome, insulating plug and mouthpiece are removed, and the outer legs of the insulating plug wires are insulated. A primer tin is then taken and fitted with two detonators arranged "in series." After the detonators have been carefully tested the priming charge of dry guncotton is placed in the primer tin, the detonators are inserted, the mouthpiece screwed up tight and the primer is lowered into the mine. Care is taken that no undue force is used and that the ends of the wires are carefully insulated and kept clear of any battery. After the primer tin is in place, the mouthpiece of

the mine is screwed in and the insulating plug properly screwed into it. Lastly the dome is screwed on and the chains shackled on to the mine.

The mines are kept moored to the bottom by means of sinkers and mooring ropes. The buoyancy of a 500-pound observation



Line of Observation Mines

mine, being 100 pounds, it is necessary to have mooring of some considerable strength, especially if the mine is laid in a strong tideway or current. The sinker weighs about 500 pounds. It is made of wrought iron and is circular with a nearly flat top and curved bottom. Its diameter is about two feet, the thickness varying according to the weight. The bottom of the sinker is slightly concave so as to give greater hold and suction on the ocean's bed. The top has three lugs to which the mooring ropes and trippers for exercise are secured. The mooring ropes are made of flexible steel wire rope, of about 2-inch size, and with a breaking strain of about six tons. When mining for exercise a tripper chain is stopped along the cable, of sufficient length to reach from the sinker to the winch in the boat, to enable the sinker to be weighed without in any way damaging the cable.

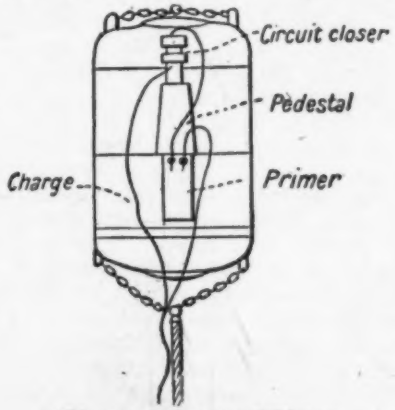
Special launches are generally provided for laying observation mines. The mines are usually laid in lines of six mines to the line. The two ends of the line are marked by a buoy at each end. To deceive the enemy various buoys are laid all about the mine field, but the operator on shore, of course, has the proper buoys accurately in sight and in line. When the enemy passes between the two-mark buoys of any particular line of mines the firing key of the battery is pressed and the line of mines fired.

In laying the mines particular care is taken that they are never less than 12 feet above the cable as it has been found by experiment that the explosion of the mines nearest the battery has in some cases cut the cable before the mines further along the line have fired. The best depth of a 500-pound observation mine below the surface is about 50 feet.

ELECTRO-CONTACT MINES.

Electro-contact mines are intended for explosion when in actual contact with the ship's bottom and hence there is no need for it to contain such a heavy charge as the observation mine. The explosive charge of an electro-contact mine is about 75 pounds of wet guncotton sufficient to sink the most powerful war vessel. It is so absolutely under the control of the operator that it can be put out of action immediately by the very simple process of disconnecting the firing battery. On the other hand its peculiar construction prevents its being fired unless in actual contact with the ship's bottom or unless subjected to a very severe blow.

The electro-contact mine consists of a cylindrical iron case with its ends rounded off and the outside fitted with eyebolts for connecting the sinkers to it. The charge is stowed in copper cases, the center one having a hole in it for the reception of the primer tin. The bottom of the mine is fitted with an insulating plug, the wires being rove through the insulating plug and eight feet long, one of them being marked to distinguish it from the other. In the center



Electro-Contact Mine

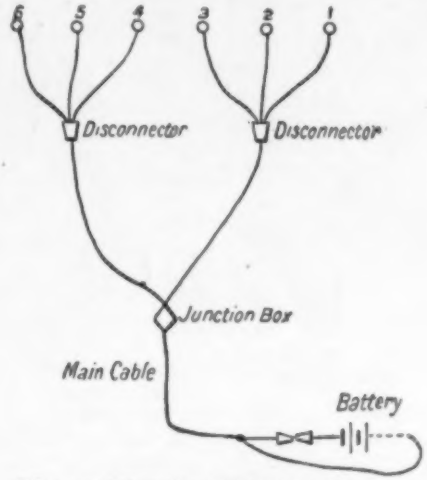
of the mine and over the charge is a platform on which is fixed a pedestal, and on top of this pedestal stands what is termed the "circuit closer." The purpose of this instrument is to complete the electric circuit when the mine is struck by a passing ship. The circuit closer used in the navy

consists of a vertical steel cylinder and, passing through the mouthpiece and insulated from the body of the cylinder, is an iron spindle which points down into the tube. The lower part of the cylinder is filled with the purest re-distilled mercury up to a point just below the other end of the spindle, to such a height that when the circuit closer is tilted over to an angle of 70 degrees but not less, the mercury should come into contact with the spindle, and by doing so should complete the circuit running through the wires connected with it. The greatest care has to be taken that the mercury is kept perfectly clean and dry, otherwise a scum of oxide forms on its surface and prevents the contact being perfect.

Electro-contact mines are laid in groups of three, each group with its three connecting cables being brought to a disconnector box, the latter being in turn connected by connecting cables to a multiple junction box at the end of the multiple cable. The purpose of the disconnector box is to cut a mine out of circuit after it has been fired by contact, so that when the circuit is completed in another mine it will not be short-circuited by the broken ends of the exploded mine; the disconnector of each mine is therefore in series with that mine, the bridges fusing simultaneously. The box is closed and made water-tight by means of a mouthpiece similar to that used to close up a primer tin in an observation mine.

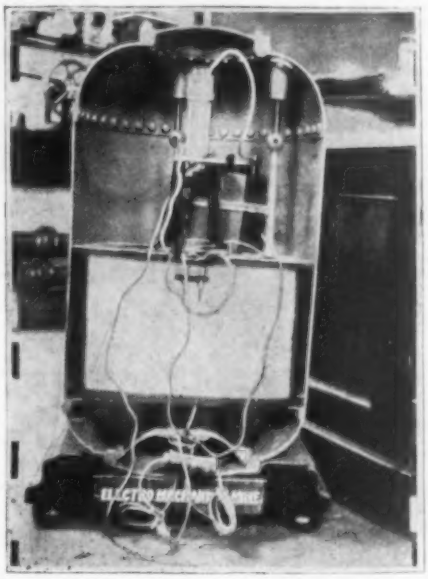
The junction box is simply an iron box containing the junction of the main with the branch cables. The ends of the cables are "puddinged," drawn together and connected inside the junction box. The puddings of the branch cables are nipped by hooks which have their lower ends threaded and screwed down by a nut outside the box. The cable used in the navy for electro-contact mines is similar to that used for all other mining and is 1,000 yards long. It is cut into eight lengths, six lengths of 100 yards and two lengths of 200 yards, and puddings are formed at each end. As will be seen from the diagram, each mine is connected with its disconnector box by a 100-yard length, and each disconnector box is connected to the multiple junction box by a 200-yard length. The main cable between the junction box and the battery is a 7-core one of the same pattern as that which is used with observation mines.

The shore or observation end of the cable has a firing battery of twenty boat's cells connected up to it, the core and armoring of the cable being taken to the opposite



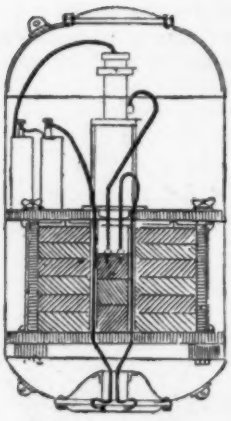
Plan of Laying Electro-Contact Mines

terminals. When it is wished to place the mines in action, the battery is plugged into the circuit and closed, and all that is then required is the bumping of one of the mines



Electro-Mechanical Mine Showing Interior

by a passing ship, and the consequent completion of the circuit by the tilting of the



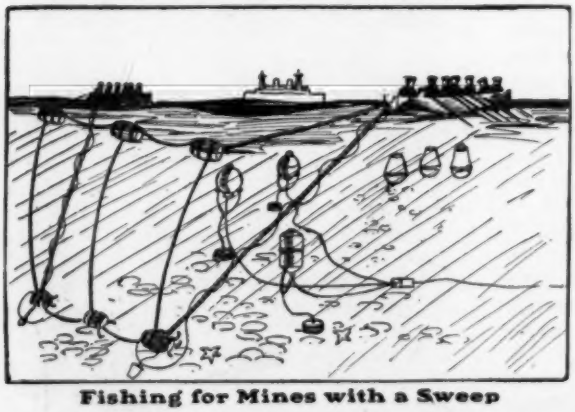
Electro-Mechanical Mine

mercurial circuit closer. The act of doing this fires the detonators and the mine.

ELECTRO-MECHANICAL MINES.

Electro-Mechanical mines are the most dangerous type of all, at least to their users. Each mine after being laid is left entirely to its own devices, being under no control whatever of the operator. They are not used for the defence of harbors, but for blocking entrance to an enemy's port and the one great advantage about them is that they can be laid expeditiously either from a ship or a boat in any position or order.

In construction the electro-mechanical mine is identical with that used for electro-contact mining, the same mine being used for either purpose; the battery of the electro-mechanical mine, however, being inside the mine and consisting of two boat's cells A short wire leads from the upper terminal of the circuit closer to the terminal of one of the boat's cells; another short wire leads from the lower terminal of the circuit closer to one of the detonators in the primer. The two inner legs of the wires leading through the insulating plug are connected to the terminal of the other boat's cell and the other detonator respectively. In the base of the mine, outside the insulating plug and protected by the protecting plate, is placed what is called a circuit breaker, into which the two outer short legs of the insulating plug wires are fitted. This current breaker consists of a brass cylinder in which work the ebonite disks with two insulated wires fitted at their inner ends with copper disks. Between these disks is poured a certain quantity of melted sugar, which is allowed to harden and thereby insulate the two disks from one another. When the mine is lowered into the water this cake of sugar is gradually dissolved and the ends of the two wires come together, thus completing the circuit; or rather the circuit is completed when the mine is tilted and the mercury in the contact closer touches both its terminals.



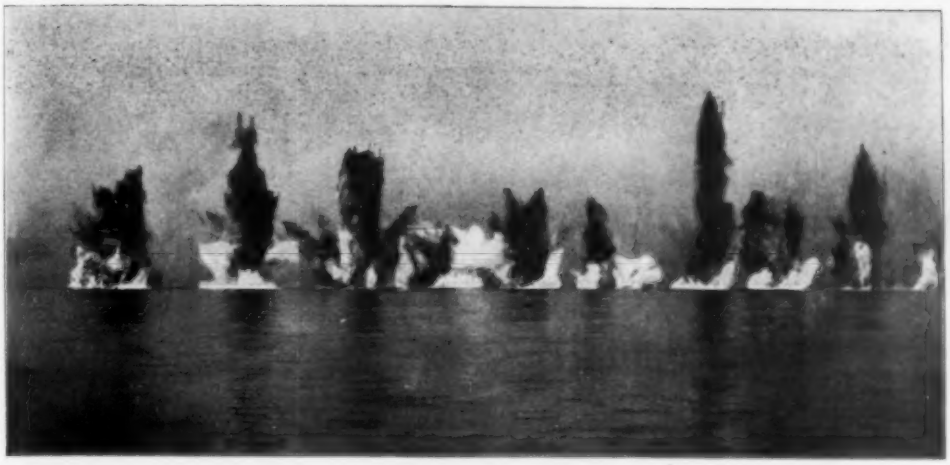
Fishing for Mines with a Sweep

MINE DESTROYING.

When mines have been laid it becomes necessary for the enemy to destroy them before it dares to enter the harbor. This is a most dangerous undertaking and is carried on with carefully considered scientific principles. The generally employed method of "mine destroying" is by means of countermining. This consists in the destruction of a mine field by laying a fresh line of mines across it and exploding them. When this task is successful and all the mines are exploded nearly simultaneously there is a great commotion and tons of water are hurled high in the air as if it were from the eruption of a volcano at the bottom of the sea.

A line of countermines usually consists of twelve 500-pound mines of the same pattern as observation mines. The cable is cut in the same way as the cable in the observation mine circuit—namely, 1,440 feet long with six branches 60 feet long forked into it at intervals of 180 feet, the two ends being 90 feet long and 450 feet long respectively, and as two of these circuits are used for the 12 mines, a line will clear a channel 720 yards long. The firing battery consists of two lots of 80 boat's cells, one at each end of the cable.

"Sweeping" and "creeping" are other methods of mine destroying. In sweeping, the mines are fished for by means of a sweep attached to two boats and when the sweep encounters an obstruction, which is determined by a pulling on the lines, the charges of guncotton attached to the sweep are exploded by means of a firing battery on the boat. It



The Mine in Naval Warfare. Explosion of a Line of Mines by Countermining

takes several sweeps to clear a channel of mines and the process is not very satisfactory.

"Creeping" is one of the most efficacious modes. The object in creeping is not to catch the mines themselves, but the electric cables and therefore the operation is usually carried on near the shore where the cables are liable to be found lying in comparatively shallow water. After the cables are severed by exploding grapnel, the severed line is caught up, connected to the firing battery on the boat and the mines thus discharged.

Some Facts About X-Rays

By N. O. Nelson

The prevailing idea in the minds of most people regarding the X-ray is that it is the light of great brightness—something far surpassing, but in the nature of an electric arc lamp or calcium light. They argue that as it is able to penetrate nearly all substances opaque to ordinary light, it must be powerful indeed and should appear so to the naked eye. Nothing is further from the fact, for, on the contrary, the X-rays are invisible to the eye, and the passing of the rays are only known by the effects they produce and by interposing in their path certain chemical substances which have the power to "fluoresce" or show phosferininse. To produce that phenomena known as the X-ray, an electric current of extremely high pressure or electro-motive force and comparatively small quantity or amperage is sent through a glass tube which is exhausted of nearly all air and is therefore almost a complete vacuum. A "Geissler" tube or the ordinary incandescent electric light bulb is also exhausted to a degree, but falls far short of the vacuum required in a Crooke's X-ray tube. A static machine, either of the type known as the Wimshurst or the simpler Toepler-Holtz, generates the right kind of electricity. A Rhumkorf coil, which simply transforms a low energy current into one of greater energy, is commonly used to excite or illuminate a Crooke's tube. The static machine or coil transformer bears the same relation to an X-ray tube that the dynamo does to an incandescent lamp. The X-ray is but little used outside of the medical profession. The physician finds it useful not only to locate bullets, needles or the buttons baby has swallowed, but also in repairing broken bones. After a job of bone-setting is done he can watch the progress of knitting and see if it goes on satisfactorily or not Last, but not the least of the properties of the X-ray, is its ability to destroy ulcerous growths of various kinds in the human body. Malignant tumors and certain skin diseases are readily healed by exposure to the X-rays. Whether its action is a destroyer of bacteria and cell life or whether the rays simply render the substance upon which the parasite lives unfavorable to their growth, is yet to be determined. Much harm has

been done to the cause of the X-ray by its reputed burning qualities. The daily press gives hair-raising descriptions of how seriously this or that person was "burned" by the X-ray. Any time harm has been caused by the new light it can generally be traced to some one who applied it, ignorant of its power for good or bad. That the X-ray will destroy healthy tissue if exposed long enough to its action is not denied. Therein lies its power to heal. An X-ray burn is very similar to a sun burn. If you expose your bare back to the hot July sun for one-half hour daily for a week, you will have a serious burn, in many respects like an X-ray burn. To cause the latter, almost the same length of exposure is necessary. For a radiograph or X-ray picture of a hand, an exposure of but one second is now necessary with modern apparatus, while a view of the ribs or spine may be made in six to ten seconds, so the danger of a burn during a single exposure is indeed remote.

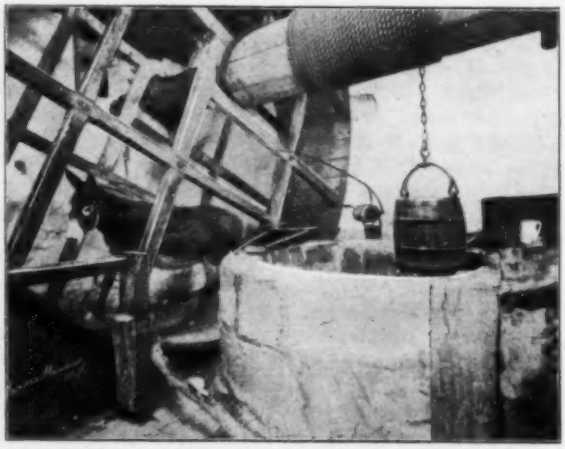
Nelson Static Machine

The process of making an X-ray picture is more simple than is generally supposed. The chloride of silver or a photographic dry plate is affected very quickly when exposed to the rays. No camera is necessary. A dry plate of sufficient size is wrapped in several thicknesses of black and yellow paper to protect it from ordinary light. Lay it on the table, sensitive side up, and place your hand or whatever object you want to photograph on it. Support your vacuum tube 8 to 20 inches above it and attach your current. (See page 195 of Snow's "Electro-Therapy.") The rays will penetrate the paper covering and the flesh of your hand, but the bones being of greater density make a shadow on the plate and leave the chloride of silver unaffected. To produce the finished picture, the plate is developed, dried and printed from in the ordinary manner. No substance has yet been found which can successfully resist the penetration of the X-rays. The metals come nearer to it than other materials. Lead, gold and platinum form the best resistance. Cast iron and brass are more easily penetrated, while aluminum is but little better than paper. The shadow of a coin behind six or eight inches of pine may be easily seen, even with very low power apparatus. Paradoxical as it may seem, clear glass offers almost the same resistance that iron does.

The fluoroscope offers the best means for detecting the presence and value of the X-ray. The fluoroscope in ordinary use consists of a light-proof box, one side of which is made of a screen or cardboard cover coated on the inside with fine crystals of platino-barium cyanide or tungstate calcium, which fluoresce brightly when exposed to the X-rays. The opposite end of this box has an opening shaped to fit tightly over the face, to exclude ordinary light. Any object opaque to the rays will cast its shadow on this screen when placed between it and the source of the rays.

AN ENGLISH DONKEY WHEEL.

For generations donkeys of a single line have trodden the great wheel shown in the cut. As the patient beast treads, the wheel revolves and winds or unwinds, as need may be, the strong cable from which the bucket is suspended—on the same principle as our own old-fashioned structures.



Donkey Wheel at Carisbrooek Castle

American Machinist says this well is located at an ancient castle in England and is 240 feet deep. A windlass on the side of the well is used for lowering a candle to show the depth.

Great Buildings of America

National Bank Of Commerce, St. Louis

The National Bank of Commerce Building is one of the pride structures of St. Louis. It was built in 1902 at a cost of nearly $1,000,000. It is twelve stories high and is entirely of stone and steel with marble and bronze finish. The structure is considered a skyscraper in St. Louis, where the people have not taken to tall buildings as they have in New York and Chicago. The basement and first, second and twelfth floors are used by the National Bank of Commerce, which has a capital of $7,000,000 and is one of the leading financial institutions of America. The twelfth floor is used as a restaurant for the bank officers and employes.

Pride Building of the World's Fair City

PROPOSED RAILWAY FROM WINNIPEG TO HUDSON BAY.

If, as is proposed, a railroad is constructed from Winnipeg to Hudson Bay, connecting there with a line of ocean steamers for all great ports, a new commercial route will have been opened which will prove of great industrial value to Canada and the United States. With better facilities for moving products, the development of vast areas must certainly follow. Lands for grazing purposes and for growing grain, vast forests of spruce, tamarack and poplar; building stone, minerals, fish of all kinds, oil from whales, porpoises and walruses; these are the riches the new road would make accessible. Two hundred million fertile acres are drained by the rivers and lakes finding their outlet on the west shore of Hudson Bay.

Popular Mechanics' special five-year subscription offer for $3 is proving exceptionally attractive. Those who find Popular Mechanics of interest and assistance to them should not fail to avail themselves of this chance. We will give the assurance to all that Popular Mechanics will continue to improve in the future as it has in the past.

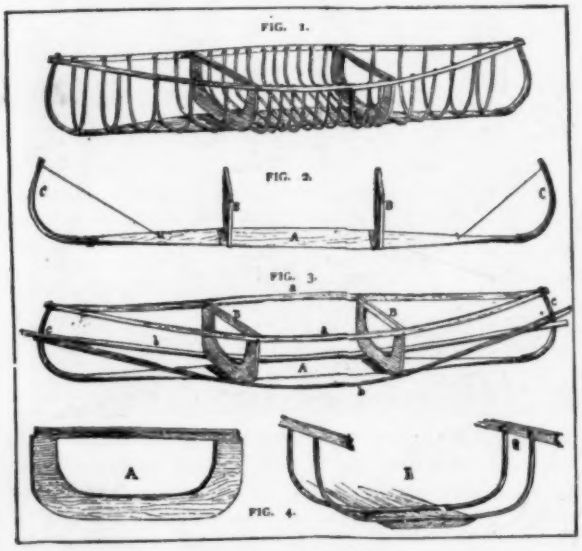
MECHANICS FOR YOUNG AMERICA

Rowing in a Paper Boat

How to Make a Paper Boat

It is Light and Can Easily Be Carried About.--A Barrel Sail Boat

Without a boat, successful fishing is nearly impossible under many conditions. Boats are expensive to buy, and they are heavy and bunglesome and often insubstantial. So why not have a perfectly successful boat suited to your own needs and one that is inexpensive, by making it yourself. It is difficult for an amateur boat-maker to obtain the right kind of lumber for the hull of a row boat, and after the lumber is obtained, it is still more difficult to cut it off and bend it in the proper shape for the boat. If you have not the facilities for making a wooden boat and if you want a light, serviceable boat, why not make it out of paper?



Now you might think it absurd to advise making a paper boat, but it is not, and you will find it in some respects and for some purposes better than the wooden boat. When it is completed you will have a canoe, probably equal to the Indian's bark canoe. Not only will it serve as an ideal fishing boat, but when you want to combine hunting and fishing you can put your boat on your shoulders and carry it from place to place wherever you want to go and at the same time carry your gun in your hand. The total cost of such a boat is $6.17. Here is how to make a paper boat:

Make a frame (Fig. 1) on which to stretch the paper. A board about a foot wide, an inch thick and say 11 feet 6 inches long is taken as a kind of keel, or backbone, and is cut tapering for about a third of its length, toward each

end, and beveled on the outer edges (A, Fig. 2). The cross-boards (B, B, Fig. 2) are next sawed from a pine plank one inch thick. Shape these as shown by A, Fig. 4, 13 inches wide by 26 inches long, and cut away in the center to avoid useless weight. Fasten them cross-wise to the bottom-board as shown in Figs. 1 and 2, with long stout screws, so as to divide the keel into three nearly equal parts. Then add the stem and stern pieces (C, C, Fig. 2). These are better, probably, when made of green elm. Screw the pieces to the bottom-board and bend them, as shown in Fig. 2, by means of a string or wire, fastened to a nail driven into the bottom. Any tough, light wood that is not easily broken when bended will do. Green wood is preferable because on drying it will retain, to a considerable extent, the shape into which it has been bent. For gunwales (a, a, Fig. 3), procure at a carriage factory, or other place, some light strips of ash, about 12 feet in length, 1½ inches wide, and ⅜ inch thick. Nail them to the cross-boards and fasten to the end-pieces (C, C,) in notches, by several wrappings of annealed iron wire or copper wire, as shown in Fig. 3. Copper wire is better because less apt to rust. For fastening the gunwales to the cross-boards use nails instead of screws, because the nails are not apt to loosen and come out. The ribs, which are easily made of long, slender switches of osier willow, or similar material, are next put in, but before doing this, two strips of wood (b, b, Fig. 3) should be bent and placed as in Fig. 3. They are used only temporarily as a guide in putting in the ribs, and are not fastened, the elasticity of the wood being sufficient to cause them to retain their position. The osiers may average a little more than a half-inch in thickness and should be cut, stripped of leaves and bark and put in place while green and fresh. They are attached to the bottom by means of shingle nails driven through holes previously made in them with an awl, and are then bent down until they touch the strips of ash (b, b, Fig. 3), and finally cut off even with the tops of the gunwales, and notched at the end to receive them (B, Fig. 4). Between the cross-boards the ribs are placed at intervals of two or three inches, while in other parts they are as much as five or six inches apart. The ribs having all been fastened in place as described, the loose strips of ash (b, b, Fig. 3) are withdrawn and the framework will appear somewhat as in Fig. 1. In order to make all firm and to

Boy Carrying a Paper Boat on His Shoulders While Hunting

prevent the ribs from changing position, as they are apt to do, buy some split cane or rattan, such as is used for making chair-bottoms, and, after soaking it in water for a short time to render it soft and pliable, wind it tightly around the gunwales and ribs where they join, and also interweave it among the ribs in other places, winding it about them and forming an irregular network over the whole frame. Osiers probably make the best ribs, but twigs of some other trees, such as hazel or birch, will answer nearly as well. For the ribs near the middle of the boat, twigs five or six feet long are required. It is often quite difficult to get these of sufficient thickness throughout, and so, in such cases, two twigs may be used to make one rib, fastening the butts side by side on the bottom-board, and the smaller ends to the gunwales, as before described. In drying, the rattan becomes very tight and the twigs hard and stiff.

The frame-work is now complete and ready to be covered. For this purpose buy about 18 yards of very strong wrapping-paper. It should be smooth on the surface, and very tough, but neither stiff nor very thick. Being made in long rolls, it can be obtained in almost any length desired. If the paper be one yard wide, it will require about two breadths to reach around the frame in the widest part. Cut enough off the roll to cover the frame and then soak it for a few minutes in water. Then turn

the frame upside down and fasten the edges of the two strips of paper to it, by lapping them carefully on the under side of the bottom-board and tacking them to it so that the paper hangs down loosely on all sides. The paper is then trimmed, lapped and doubled over as smoothly as possible at the ends of the frame, and held in place by means of small clamps. It should be drawn tight along the edges, trimmed and doubled down over the gunwale, where it is firmly held by slipping the strips of ash (b, b) just

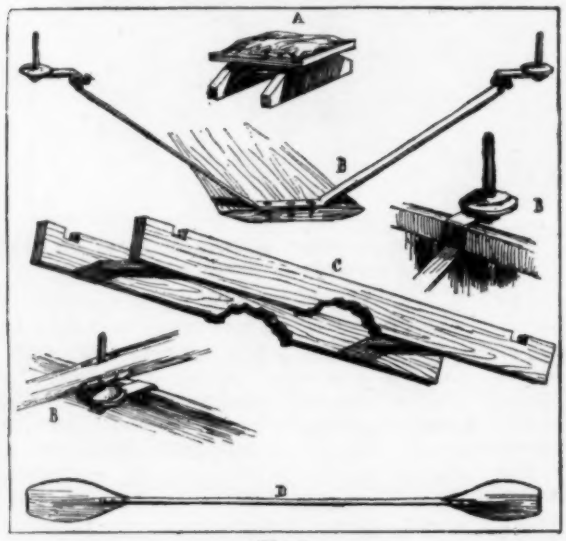


Fig. 5.

inside of the gunwales into notches which should have been cut at the ends of the cross-boards. The shrinkage caused by the drying will stretch the paper tightly over the framework. When thoroughly dry, varnish inside and out with asphaltum varnish thinned with turpentine, and as soon as that has soaked in, apply a second coat of the same varnish, but with less turpentine; and finally cover the laps or joints of the paper with pieces of muslin stuck on with unthinned varnish. Now remove the loose strips of ash and put on another layer of paper, fastening it along the edge of the boat by replacing the strips as before. When the paper is dry, cover the laps with muslin as was done with the first covering. Then varnish the whole outside of the boat several times until its presents a smooth shining surface. Then take some of the split rattan and, after wetting it, wind it firmly around both gunwales and inside strip, passing it through small holes punched in the paper just below the gunwale, until the inside and outside strips are bound together into one strong gunwale. Then put a piece of oil-cloth in the boat between the cross-boards, tacking it to the bottom-board. This is done to protect the bottom of the boat.

Now you may already have a canoe that is perfectly water-tight, and steady in the water, if it has been properly constructed of good material. If not, however, in a few days you may be disappointed to find that it is becoming leaky. Then the best remedy is to cover the whole boat with unbleached muslin, sewed at the ends and tacked along the gunwales. Then tighten it by shrinking and finally give it at least three coats of a mixture of varnish and paint. This will doubtless stop the leaking entirely and will add but little to either the weight or cost.

Rig the boat with wooden or iron rowlocks (B, B, Fig. 5), preferably iron, and light oars. You may put in several extra thwarts or cross-sticks, fore and aft, and make a movable seat (A, Fig. 5). With this you will doubtless find your boat so satisfactory that you will make no more changes.

For carrying the boat it is convenient to make a sort of short yoke (C, Fig. 5), which brings all the weight upon the shoulders, and thus lightens the labor and makes it very handy to carry.

The approximate cost of materials used in the construction of the canoe are as follows:

Varnish, 5 qts.	$1.90
Paper, 18 yds.	1.20
Cloth, 8 yds.	.72
Bottom-board	.60
Gunwales	.50
Cross-boards	.25
Paint	.50
Split rattan	.25
Nails, screws, wire, etc.	.25
Total	$6.17

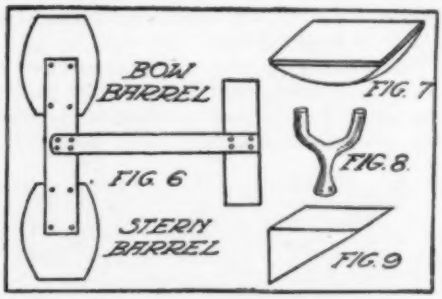
It may be that you are in position to get many of these materials for nothing and thus lessen the cost.

BARREL BOAT FOR SAILING.

For sailing the barrel boat is very easily constructed and it is one of the best devices known to instruct a young person in the art of managing sails. The barrel boat can be put together in one day, and the only part that needs to be bought is the material for the sail. Fig. 6 shows the hull of the barrel boat. It consists of a bow barrel and a stern barrel, joined together by one strong plank and a simple outrigger which extends

from the plank. In order that the barrels may not present a flat front, which would be difficult to push through the water, they are, as shown in the illustration depicting the completed boat, fastened to the plank at an angle. The angle is made by placing between each barrel and the plank a triangular shaped brace, such as shown in Fig. 9. Both barrels must be covered with tar and painted so that they will be absolutely water-tight.

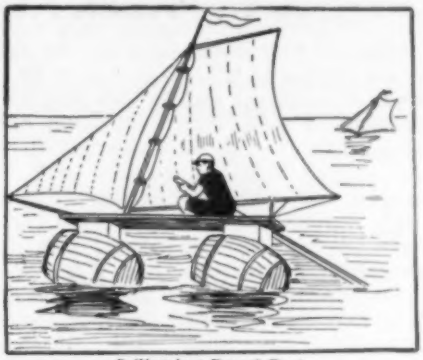
The outrigger (Fig. 7), is a small scow-



Rigging of Barrel Boat

shaped affair, about 2½ feet long and 1 foot wide. An ordinary oar or paddle is used for steering. A notched stick (Fig. 8) or an iron rowlock can be fastened over the stern barrel to hold the steering oar.

The barrel boat, when completed, will consist of two large air-tight compartments



Sailing in a Barrel Boat

and is, therefore, unsinkable, and because of the out-rigger is very difficult to tip over. Hence it is safe to carry quite a large spread of sail. In a stiff breeze the barrel boat is more seaworthy than rapid, because the waves slap against the ends of the barrels, but in a light breeze when the water is smooth, the barrel boat compares favorably in point of speed with the ordinary small sail boat.

HOW TO MAKE A WATER WHEEL.

Considerable power can be developed with an overshot water wheel erected as in Fig. 1. This wheel is made with blocks of wood cut out in sections as indicated by the lines, so as to form the circle properly. The wheel can be about 24 inches in diameter with

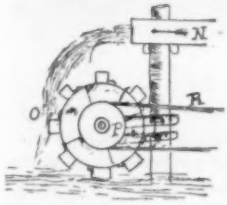


Fig. 1

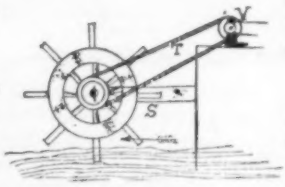


Fig. 2

good results and about 10 inches wide. Get some tin cans and attach them around the wheel as shown. Bore the wheel center out and put on the grooved wood wheel P and a rope for driving R. This rope runs to a wooden frame in the manner illustrated and the water is carried in a sluice affair N to the fall O, where the water dippers are struck by the volume and a power equal to two to four horsepower ordinarily generated. This power can be used for running two or three sewing machines, fans, fret-saws, and the like. Another form of water wheel is shown in Fig. 2. This is driven by an underflow of current. This type of wheel can be made on lines similar to the other, only that the paddles are of wood and extend outward as shown. The wheel is supported in a bearing on the piece S. A belt T communicates the power to the wheel V and from here the power is carried to any desired point.

To find the horsepower which a belt can safely transmit, multiply the diameter of the driving pulley in inches by the revolutions per minute, and by the width of the belt in inches. Divide the resulting product by 3,300 for single belting, or 2,100 for double belting.

A Hungarian inventor claims to have solved the smoke difficulty by employing porous plates or bricks made of a composition containing lime and fuel of different degrees of combustibility arranged behind or between portions of the fuel in a furnace. These serve as desulphurizing or purifying filters for the furnace gases.

"War Airship" to Destroy Russian Fleet

Californian Claims His New Aerial Craft Can Rain Dynamite on War Vessels From Its Height in the Clouds

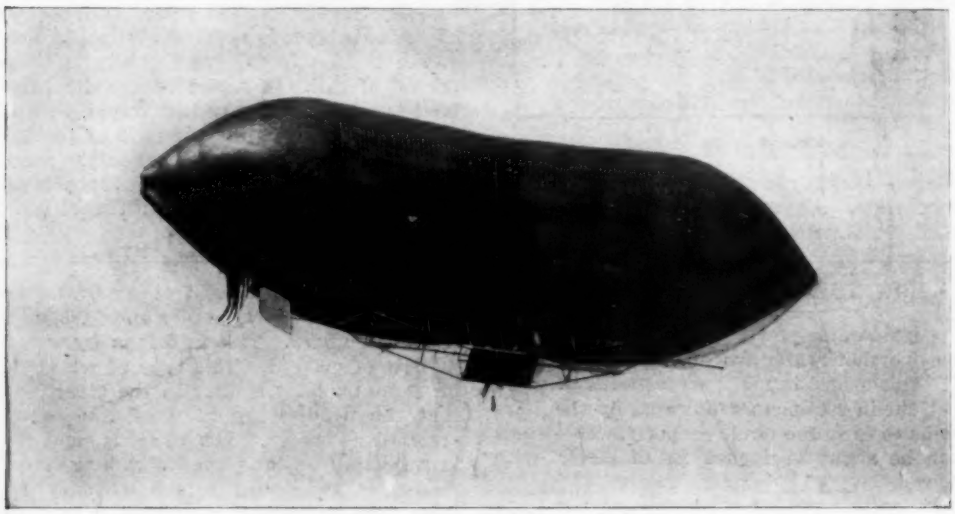
Destruction of the Russian fleet by means of an airship is a plan conceived by Dr. Greth of California and for this purpose he has built an aerial craft, termed the "California Eagle." The Japanese government has entered into negotiations with the inventor and will purchase the "war airship" provided that the final test, to be made at San Francisco in a few days proves all the inventor claims for it. An old barge will be anchored off the Heads of Golden Gate, when Dr. Greth and Captain Baldwin, of the United States Army, will attempt to show the agents of the Japanese government how a battleship may be destroyed by dropping dynamite from the airship, which at all times will be kept out of range of the enemy' guns.

The result of the experiment may be of great importance to the science of war in all nations.

In the preliminary tests the "war airship" has proved itself most successful. It was able to rise to any desired altitude, was easily steered and without difficulty was driven in any direction. Dr. Greth finds that his craft has suffered some disadvantage from the 5-horsepower engine he employed to propel it. Hence he is building a new engine of more than 40-horsepower which will be ready for use soon.

The balloon of the "California Eagle" is cigar-shaped, 80 feet in length, with an extreme diameter of 25 feet, having a capacity of 50,000 cubic feet of hydrogen gas. Suspended directly underneath in a central line, is the cage, the structural material of which is steel tubing.

The guiding power is incorporated in twin, sheet steel, eight-blade, screw propellers, six feet in diameter, arranged on either side, amidships, and capable of performing about 1,800 revolutions per minute. They are under control of the steering gear in the car, and, aside from their propulsive power, operate in lieu of a rudder, although a canvas rudder is also used as an auxiliary. They can be deflected at any angle without stopping or reversing the engine, and, according to the angle at which they are placed, the ship can be moved in any direction, which the inventor claims no other builder of an airship has ever accomplished with such a degree of simplicity. The propellers run in ball bearings and their axis is rotated and changed by means of a mechanical worm and worm wheel. Santos-Dumont has but one propeller, fixed and



"War Airship," the California Eagle

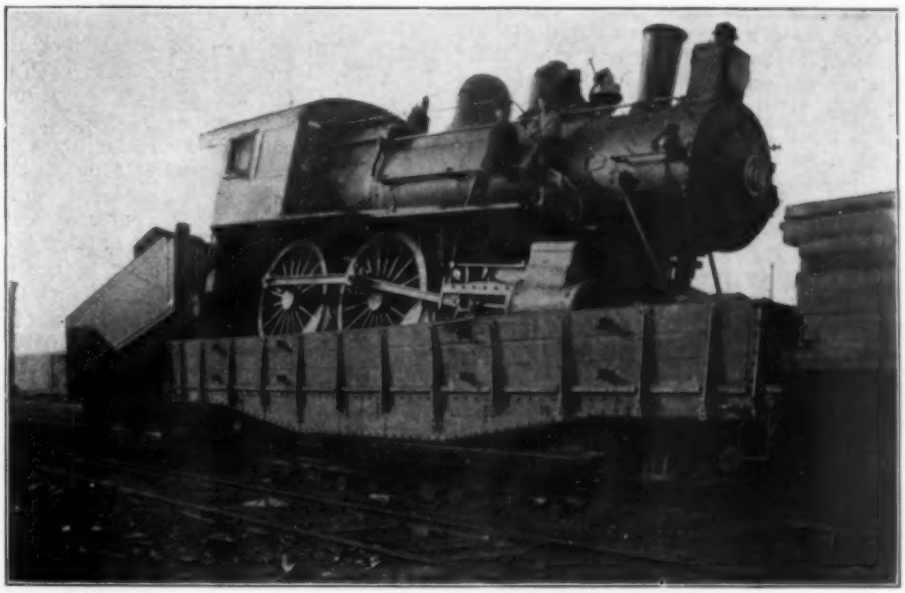
rigid, and steers with a canvas rudder, which, Dr. Greth says, does not take action rapidly until the ship is under considerable headway.

Dr. Greth claims that under anything like favorable conditions, he can drive his ship forward at a speed of from 30 to 40 miles per hour.

ODD ACCIDENT ON THE PENNSYLVANIA.

Results of the Mix-up Prove the Greater Strength of Modern Rolling Stock

An accident that happened on the Pennsylvania railroad at Harrisburg, Pa., recently, demonstrates the increased strength and durability of railroad rolling stock. A Pennsylvania engine weighing 134,000 pounds ran into a gondola car of 100,000 pounds capacity. The engine rode right up into the car and there stopped as contentedly as if it had merely been stationing itself for a little ride about the Pennsylvania yards. The fireman and engineer recovering from their fright and seeing the damage was insignificant walked out on the running board and there had their pictures taken for the Railroad Trainmen's Journal and Popular Mechanics. The only damage resulting from the mix-up was a broken pony-wheel truck.



Locomotive Climbs Into a Gondola Car

Plans have been decided on for leveling the tunnels under the Chicago river without interrupting traffic through them.

PATENT FOR COLOR PHOTOGRAPHY.

Johns Hopkins Professor Invents Process of Taking Pictures of Different Shades

After five years of investigation the patent office has granted to Dr. Robert W. Wood, professor of experimental physics at Johns Hopkins University, a patent covering all rights to color photography. The five years of investigation by the patent office consisted in an exhaustive research to ascertain the rights of the process to an exclusive patent which this affords all processes based upon it. The patent will protect Dr. Wood's rights upon the derivative invention. There are several photographers who claim to be the discoverers of color photography.

The process at present is valuable from an academic standpoint. The photographs cannot be made on paper, but only upon glass slides, and a special viewing apparatus or electric lantern upon a screen must be used to get the optical results. Duplicates are easily made.

EASY ELECTRICAL EXPERIMENTS

A SIMPLE ELECTRIC ENGINE.

The first electric motors were built on lines similar to the steam engine—employing a reciprocating motion similar to that of a piston, this motion being converted into rotary motion by means of a crank and fly-wheel. For a simple machine, this is still an interesting form of motor, and may be made with very little labor and expense.

It is well known that a coil of wire carrying an electric current exerts a magnetic attraction upon a piece of soft iron placed in its neighborhood. If one end of an iron rod is placed near the end of the coil, the coil tends to draw the whole rod within itself in much the same manner as a piston is pushed within a cylinder. The machine to be described employs this principle.

Two coils shown at A and B will be required. The spools for these coils are made of brass. Take a piece of brass tubing, whose inner diameter is ⅝ inch, and whose length is 3 inches. To each end of this tube solder two circular heads also of brass. These heads are ⅛ inch thick, and 1¾ inch in external diameter. In the center of one of them is a hole ½ inch in diameter. The brass spools thus formed are to be mounted as shown in the accompanying figures, so that the ends with the holes are facing each other, being supported at their outer ends by a brass yoke bent into the form of the letter U. This yoke should be made of ¼ inch material so as to be very stiff Its extreme outer dimension from left to right is 10¾ inches, and the upright arms project 4¼ inches above the base. The coils A and B are fastened to this support by means of two brass screws. Some trouble may be experienced in getting the two coils exactly facing each other, and in line. This can be the more easily accomplished by fastening one of them in place; then take a piece of straight iron rod, ½ inch in diameter and 9 inches long, and insert it in the holes in the ends of the spools. This will force the spools into line, and the screw-holes for the second spool may be located. When in place, the rod should slip freely back and forth, into and out of the coils, without striking against the spools at any point. After being thus mounted, the spools may be wound full of number 24 double cotton-covered magnet wire.

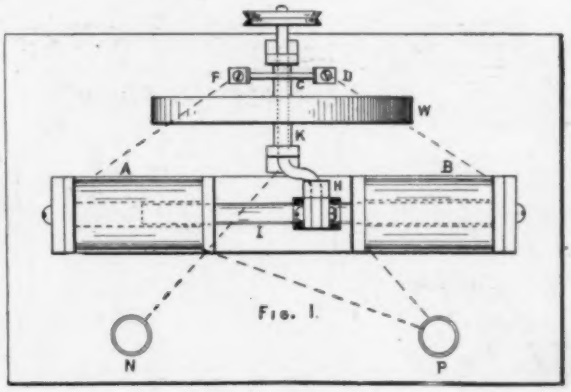


FIG. 1.

From the piece of ½-inch iron rod already mentioned cut off two pieces 4 inches in length. Thread one end of each of these for a distance of 5/16 inch from each end. To the threaded end of each rod is to be fitted a piece shown at E, Fig. 2. This piece is built up from a circular brass piece ¾ inches in diameter and 5/16 inches thick, soldered to the center of a strip of brass, 3 inches long, ¾ inch wide and ⅛ inch thick. The circular piece is bored and tapped at its center so that the whole may be screwed into place on the end of each of the iron rods. In Fig. 2, one of these rods is shown at I, with the end pieces shown at E. Between the two end pieces, which face each other, are two small blocks of brass, ¼ inch thick, ½ inch wide, and ¾ inch long. These are inserted between the two pieces E and F, Fig. 2, and a small bolt passing through the whole fastens them together. It will be necessary too, to pin the pieces in place, to prevent them from racking out of place when the motor is running.

A fly-wheel of some kind, about 6 inches in diameter will be required. It is to be mounted upon a shaft ¼ inch in diameter and 6 inches long. This shaft is supported in brass bearings, at such a height that its center is on a level with the center of the rod which moves in and out of the coils. Heat the shaft red hot, and bend one end over to form a crank, whose throw is ¾

inch. The end of this crank is to fit into the slot at S, so that as the rod I moves back and forth, the crank may revolve smoothly without binding at any point. A little filing and bending will secure this result.

In Fig. 1 the wheel is shown at W mounted on the shaft, between two bearings. A sleeve, shown at K, driving tightly upon the shaft, prevents end play in one direction. Another sleeve, shown at C, performs the same office on the other side of the wheel, but it is of special construction. Its form is shown in the upper portion of Fig. 2. A piece of brass tubing, fitting tightly to the shaft is cut of such a length that it will fit into the space between the wheel and its bearing. To this sleeve is soldered a thin piece of brass, at right angles, its outer rim being circular, and extending nearly half way around the sleeve. It may be best to make it an exact semi-circle at first, and then to reduce it by filing.

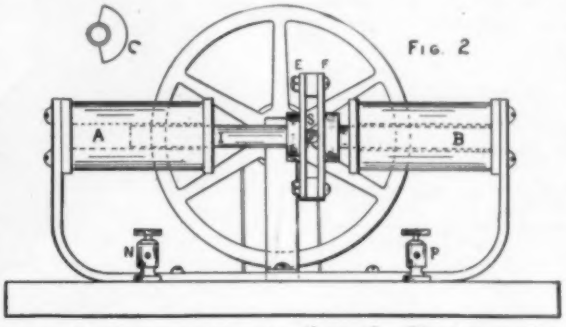


FIG. 2

This is a contact piece, upon which the action of the motor depends. As shown in Fig. 1, two springs D and F press upon this contact piece

Now these contacts should be made at such a time as to assist the motion of I as it moves to and fro.

That is, as I starts to move into A, contact should be made so that a current flows in A, tending to draw the iron core into the coil. As soon as I has gone to its extreme left-hand position, the circuit through A should be broken. Then as the iron rod starts toward the right, the current should be switched into B. As the springs D and F must have a little movement, so as not to be too stiff, the contact strip C should be a little less than half a circumference in length.

Five cells of a good dry battery will be necessary to run the motor or eight cells of gravity battery.

In order to prevent the rod I from turning about its own axis while running, a piece shown at H, Fig. 1, is slipped on to the crank inside of the slot. This piece is ½ inch in diameter and ½ inch thick and should drive tightly upon the shaft.

AMERICA'S LARGEST BATTLESHIP LAUNCHED.

The Virginia Slides Gracefully Into The Water While 30,000 People Cheer

The battleship Virginia, the largest vessel in the United States navy, was launched at Newport News April 5 in the presence of 30,000 persons, who cheered vociferously as the trim though monster fighter slid gracefully into the water. The battleship was christened by Miss Matilda Gay Montague, daughter of the Governor of Virginia.

The Virginia has a displacement of 14,600 tons, whereas the Maine and Missouri, recently added to the navy, have a displacement of 12,500 tons. The Virginia is 3,000 tons displacement greater than the Illinois, Wisconsin, Kentucky or Kearsarge, and 4,375 tons greater than the Oregon.

Big as is the Virginia, however, Uncle Sam will soon launch five battleships, the Connecticut, Kansas, Louisiana, Minnesota and Vermont, each 16,000 tons displacement, or 1,400 tons greater than the Virginia. The United States has twelve more battleships under construction yet to be launched, and one, the Ohio, launched but not ready for a trial trip. When all are completed Uncle Sam will have 25 battleships afloat—a number exceeded by only two navies in the world, the British and the French.

The battleship Virginia will have 24 big guns in its main battery and will be driven by engines of 18,000 horsepower. It is to have a contract speed of 19 knots. Its cost, completed, will be $3,590,000 .

Prof. Myers, superintendent of the aeronautic field at St. Louis, states the field now occupies twelve acres, and the field equipment will consist of aerodrome stalls, a two-story shed addition running along the entire north side of the field for offices, a sewing room, laboratory, machine and wood shops, storage rooms, ballast quarters and dormitory and living rooms for crews in charge of the airships in commission.

The Limit of Daring Amusement Feats

Human Missile on a Bicycle Is Hurled 56 Feet Through the Air, Lighting On a Narrow Platform

Leaping 56 feet through the air on a bicycle and 22 feet above ground, "Volo, the Volitant" has outdared all the daring and surpassed all the performers of reckless feats for the amusement of a sensation-loving public. "Looping-the-loop," "circling-the-circle" and other of the hazardous stunts of trick bicyclists are completely overshadowed by this latest and boldest of amusement exploits.

Starting from a point 45 feet from the ground, Dr. Clark mounts a 170-pound bicycle, set at an angle of 45 degrees and after attaining a velocity estimated at 85 miles an hour, machine and rider are thrown into the air by a sudden rise at the bottom of the plankway. The terrific momentum carries the performer, still upright on his bicycle, into the air to a height of 22 feet from the ground and across a gap in the staging 42 feet wide. The total distance traveled through space along the arc of the circle described by the human missile is calculated at 56 feet.

Hanging for an instant in the air with

Looping the Gap

the front wheel of his machine pointing skyward, the performer suddenly throws his head forward with the same motion used by throwing a forward somersault. This brings both wheels on a level just as the bicycle strikes the landing platform, which is seven feet above the ground. The machine seems to regain its lost impetus and shoots down an incline to the ground level where it is stopped by a "mechanic" placed 50 feet away.

The time elapsing from the instant that Dr. Clark starts on his perilous ride until he reaches the ground after his flight through space is just 4 1-5 seconds.

SPRING HEELS FOR MOTORMEN.

Motormen are the beneficiaries of the recent invention of a spring sandal to relieve them from the bad effects of constantly

Motorman's Shoe

vibrating cars. Coil springs at the heels, their tension increasing in proportion to the weight of the wearer, and hard rubber pieces for the ball of the foot are the main features of this device which has met the approval of railway company officials and physicians. The sandal weighs but 15 ounces, excluding the possibility of its being cumbersome.

For winter use overshoes along the same lines will probably take the place of the sandal.

Chicago's freight tunnel system is now being used to remove excavated material from sites of downtown districts. The tunnel cars will remove all the material from the site of the new Chicago Savings Bank, where the excavation will be to a depth of 40 feet below the sidewalk. Excavated clay will be lowered by caissons to the cars of the tunnel company, switched underground to the lake and transferred to Grant Park.

Lathe Attachments

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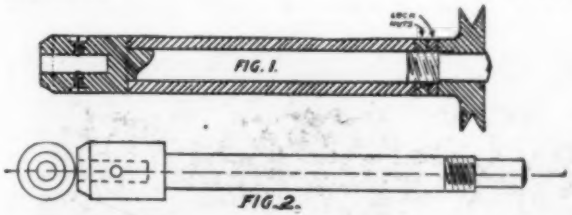
Part I. General Introduction and Description of Division Plate and Pointer,
Part II. Overhead for Lathe and Alternate Form of Same.
Part III. Milling Attachment for Rotary Cutters.
Part IV. Milling and Drilling Spindle,
Part V. Gear Wheels and Rotary Cutters,
Part VI. Suggestions on Changing Plain Lathe to Self-Acting and Screw-Cutting Lathe.

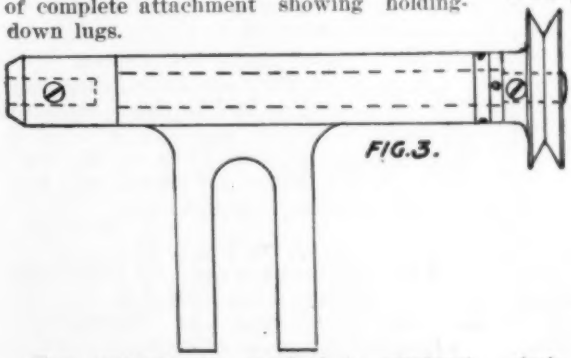
MILLING AND DRILLING SPINDLE.

For use in connection with the overhead described heretofore the milling and drilling spindle becomes a very useful accessory to the lathe and in many instances will take the place of an ornamental or eccentric chuck.

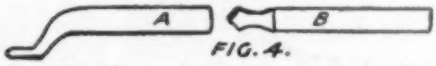


The one shown herewith is easily constructed and can be used in connection with a revolving cutter or various shaped drills, two specimens of which are shown at a and b, Fig. 4. A, Fig. 4, is a crank drill used for ornamental work, as for instance, decorating a box cover, as shown in Fig. 5. B, Fig. 4, is an ordinary straight shanked drill and needs no further description.

Fig. 1 is a sectional view of attachment with a semi-sectional view of the spindle showing chuck on the end, and method of fastening drills. Fig. 2 shows the spindle with end view of same and Fig. 3 is a plan of complete attachment showing holding-down lugs.



Two patterns are required to construct the attachment, one for the frame and one for the pulley. The frame is either cast solid or can be cored and reamed out to size to fit the shank of spindle easily, but without shake. If cast solid, bore the hole with a twist drill and run a reamer through so as to make a true hole throughout. Face the ends true with the bore. The spindle is turned with a steel or iron rod as shown, threaded at one end to take the two lock nuts shown in section at Fig. 1. The nuts should be turned and provided with tommy holes by which to tighten up. Fig. 5 shows a specimen of work that can be done, and is executed in the following manner: The circular disk or work is secured to the faceplate or on chuck on lathe mandrel. The drilling spindle with a crank drill is bolted on the slide rest so that center of spindle is on a line with center of lathe spindles. The division plate on lathe is used. Advance the drill to work and make the first circle, cutting to proper depth, and then make a chalk mark on han-



dle of slide rest to serve as a guide to insure all circles being cut to same depth.

When the first circle is cut draw back the tool and using division plate, turn the work proper distance and cut the second

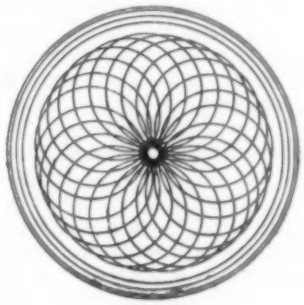


Fig. 5

circle. Continue thus until the work is completed. The specimen shown is composed of 24 circles. Many different designs

will occur to the workman as well as a variety of uses to which the spindle may be put.

THE UNITED STATES STEAMER VANDERBILT.

When, during the greatest stress of the Civil War, Cornelius Vanderbilt presented the crack liner, Vanderbilt, to the United States, the craft was admitted not to the Navy, but to the Army. The distinction was a bit of diplomacy by President Lincoln, for, due to the Commodore's stipulation that he have charge of the vessel and direct all her movements, it came near being lost to the government. The Navy could not admit a vessel under the control of a civilian and Mr. Vanderbilt's condition was positive.

President Lincoln, on hearing of the difficulty, summoned Mr. Vanderbilt to the White House and after greeting him accepted his gift with a few words of thanks; then, knowing the stipulation made it impossible to enter the ship in the Navy, added: "I will place her with the Army and assign her to the Quartermaster Department and put you in charge."

The original intention was to fill the Vanderbilt with empty casks and deliberately run her upon the Merrimac and thus sink that ship; the Vanderbilt was not used for this purpose, however, and after the Merrimac was blown up, the Vanderbilt was admitted to the Navy and placed in charge of a naval officer, the Commodore not wishing to command her after the destruction of the ironclad.

The Vanderbilt made a brave showing in several engagements, and a gold medal and a vote of thanks were awarded by Congress to Mr. Vanderbilt, an unusual distinction. In fact, the whole affair is without precedent in the history of a nation.

The United States Steamer Vanderbilt

KNIFE WORTH $5,000.

The Westminster Gazette says: "The most valuable knife in the world is to be seen in the collection of a famous firm of cutlers in Sheffield. It is large enough to fit the pocket of none but a giant, and contains 75 blades, which close up like those of an ordinary knife. Each of the larger blades is elaborately engraved, and among the subjects of these strange pictures are views of Sheffield, the city of York, Windsor Castle, Arundel Castle and a score of other famous scenes. The hafts are of mother-of-pearl, carved with great skill.

The knife is valued at $5,000.

A cooking pot is the first iron casting ever made in the territory which now constitutes the United States. It was made at a small blast furnace near Lynn, Mass., in 1642. The furnace used charcoal for fuel, had bog ore and used oyster shells as flux.

Gases from thousands of coke ovens pass off into the air and are wasted in the Connellsville coke region in Pennsylvania. These gases might be utilized, at a profit, for operating gas engines and generating electric power.

One Million a Year For Naval Gun Practice

It Costs $500 Every Time a 13-Inch Cannon is Fired--Expense to Greatly Increase

Every time one of the big 13-inch guns on the American warships is fired it costs $500. Four times a year the men are exercised in big gun practice with regulation charges, each man of the gun's crew firing four shots at these trials. There are seven men in a gun's crew on these trials. Now if you multiply seven by four, and by four again, then multiply by the number of 13-inch guns in the navy and take into consideration that every two shots cost $1,000, it is not difficult to see how fast the big guns burn up money. But the number of these largest guns is not a tithe to the 8 and 6-inch guns, in addition to the 5-inch, the 4-inch, the 6-pounders and the 1-pounders, whose number is legion and on which the practice is just as important and assiduous as on the big ones. Of course the cost of firing one of the smaller guns one time is much less, but the total cost of the practice with them is much larger because there are so many more of them to fire; so much greater practice is given with them, and they are fired so much oftener than the large guns. To fire a 4-inch common shell costs $17; a 6-pounder, $3.86; a 1-pounder, $1.14. Every ship has a battery of Colt automatic machine guns which fire cartridges in a stream fed from a belt at the rate of 400 a minute. Four times a year each man fires two belts on one of these guns. It takes a little over two minutes and it costs about $7.00 a belt.

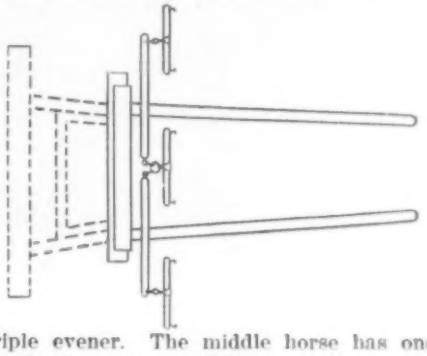
The total amount that Uncle Sam is asked to appropriate for naval target practice for the ensuing year is $1,336,000. This seems an astonishing sum to spend merely for exploding powder, but it is necessary to train the gunners to shoot straight. And this amount is small compared to what will be required when the ships now being built are added to the navy. Then this sum will have to be more than doubled, and then the annual cost for ammunition for target practice in the navy will amount to $2,690,000.

These costs allude to the regulation gun practice with actual ammunition, which has been in vogue of late years, but recently another and important custom has been added. It is the record training for the title of gun captain, which carries with it certain honor and $2.00 a month more pay. Any man is eligible to this, be he landsman, seaman, gunner or cook, and all are expected to take part in the competition. The title implies no change of duties. The cook may be a gun captain and he must continue to cook; but the title and the $2.00 extra are eagerly sought. Moreover a good record of this sort puts a man in the way of possible promotion.

The enormous cost of firing the 13-inch guns can be appreciated when it is known that the charge of black powder required for one shot is 550 pounds; of smokeless powder, 280 pounds. The steel projectile that is fired weighs 1,100 pounds. This leaves the muzzle with an initial velocity of 2,100 feet a second and would penetrate 33½ inches of wrought iron at the time it leaves the gun. With the muzzle elevated at the proper ballistic curve, a little less than an angle of 45 degrees, this projectile would go 12 miles. It is impossible to get this elevation on a ship, however.

HITCHING THREE HORSES TO A WAGON.

A method of hitching three horses to a wagon is given in the Ohio Farmer. Two wagon poles are substituted for one, and the middle horse placed between the poles, or shafts. There are two neckyokes and a



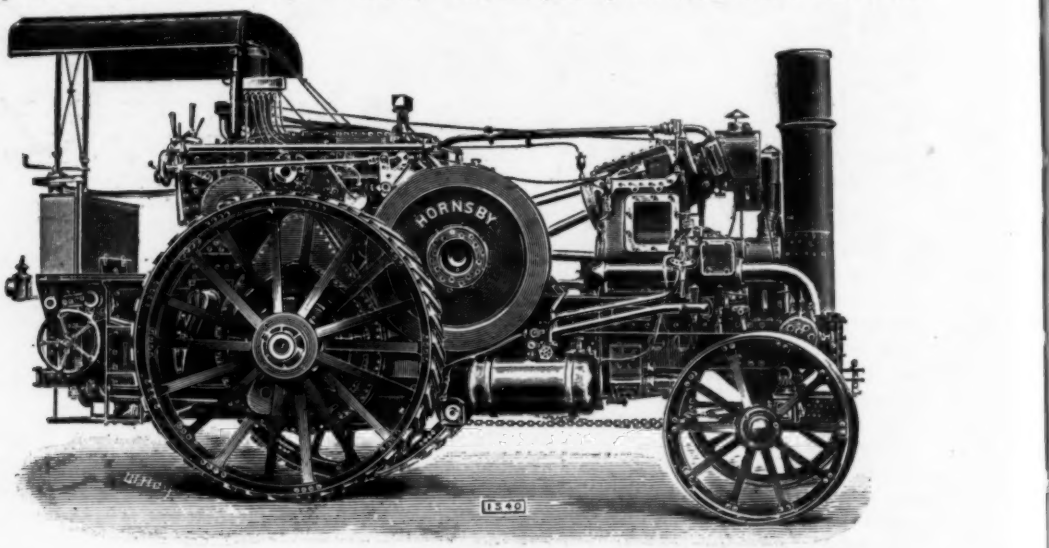
triple evener. The middle horse has one-third of each doubletree, making two-thirds of both, while each outside horse has two-thirds of the evener he is hitched to.

You are not getting all that is coming to you in this world if you do not immediately send for Popular Mechanics' Premium List. We want all our readers to get these lists because we know you will appreciate them.

ENGLISH TRACTION ENGINE WON WAR PRIZE.

A traction engine propelled by an oil engine working by natural forces, the heating of the vaporiser by means of a lamp being sufficient to start the combustion of oil vapor and compressed air, after which it works automatically, won the prize in the English War Office competition. The details of the engine are as follows:

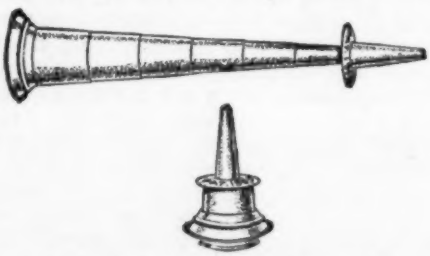
The engine has two cylinders, placed one above the other, the connecting rods being coupled up to the same crank pin, and as they work on the Otto 4-cycle principle, at alternate intervals there is an explosion given for every revolution of the crank shaft. The common crank shaft makes 350 revolutions per minute. Three oil tanks are provided with a total capacity of over 100 gallons. The oil used is refined Russian oil, but adjustments are provided so that either refined American, Scotch shale, Russian crude, Texas liquid fuel, or Burmah oils can be used. The cylinders are water-jacketed, and the water is circulated by a rotary pump round them and through a cooler, placed under the footplate, the air being drawn over the tubes by a fan. The consumption of oil fuel on good average roads in about 30 miles with the maximum load is about 350 pounds, and the consumption of water for cooling purposes for the same distance and load under one gallon. The gearing is arranged with four speeds—one and one-half, three, five, and eight miles per hour—reversing and winding gear. Every moving part and bearing has its own separate lubricator, and is supplied by a copper tube from central reservoirs. The whole of the gearing and lubricating and every movement necessary for the complete working of every function of the engine is under the control of the driver on the foot-plate.



Prize Tractor

A COLLAPSIBLE HORN.

In good season for political parades and election returns comes a new kind of horn.

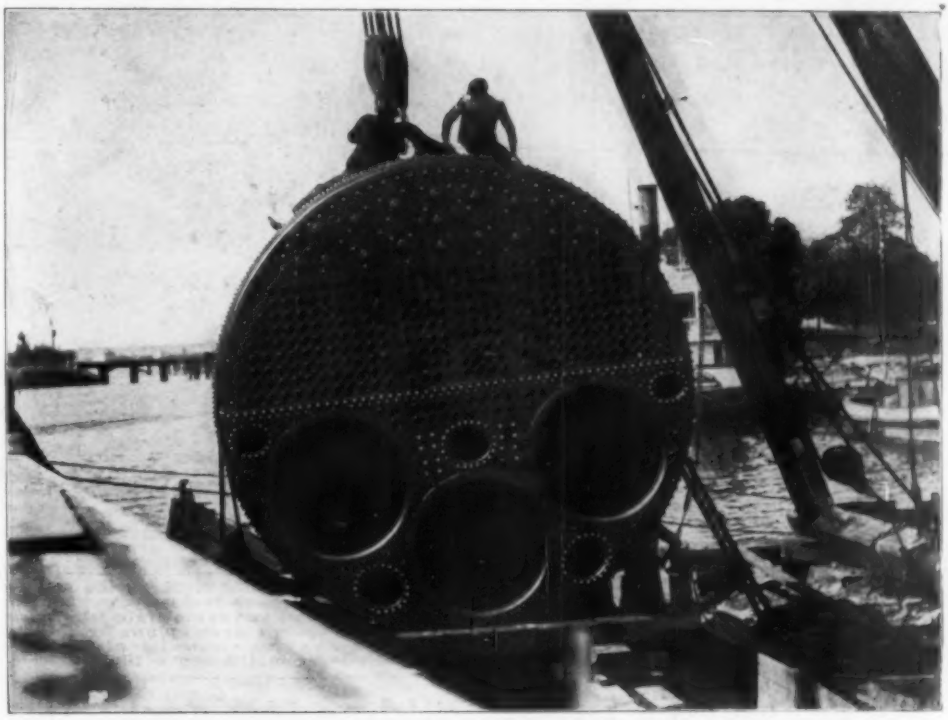


One which shuts up into small space to carry in your pocket, but when drawn out to full length is 14 inches long and produces an ear splitting blast. The illustration shows the horn extended and collapsed.

The biggest searchlight in the world, to be exhibited at the coming World's Fair, weighs nearly four tons, is of 5,250,000 candlepower and projects a beam of light seven feet in diameter.

BIG BOILERS FOR LAKE BOATS.

The steamer Santa Maria contains three of the largest boilers of their type in use on the Great Lakes. The illustration shows



Largest Steamer Boiler on the Great Lakes

one of these immense steam generators being lowered into the vessel. The boiler is 14 feet in diameter and 13 feet long, containing 278 tubes each 3½ inches in diameter. The boiler carries a working pressure of 150 pounds, and weighs 50 tons.

WONDERFUL FIRE EXTINGUISHER.

A most effective fire extinguisher has lately been exhibited in Dresden, Germany, reports U. S. Consul-General Chas. L. Cole.

The ingredients are as yet a secret, but the solution costs about five cents a pound. One of its best features is the fact that it will not damage fabrics. Severe tests of the extinguisher were made by saturating inflammable materials with petroleum and igniting them. A bucketful of the solution immediately extinguished the fire. Other tests such as lighting a vat of coal tar and petroleum, and firing stacks of railway ties and straw were made with the same results.

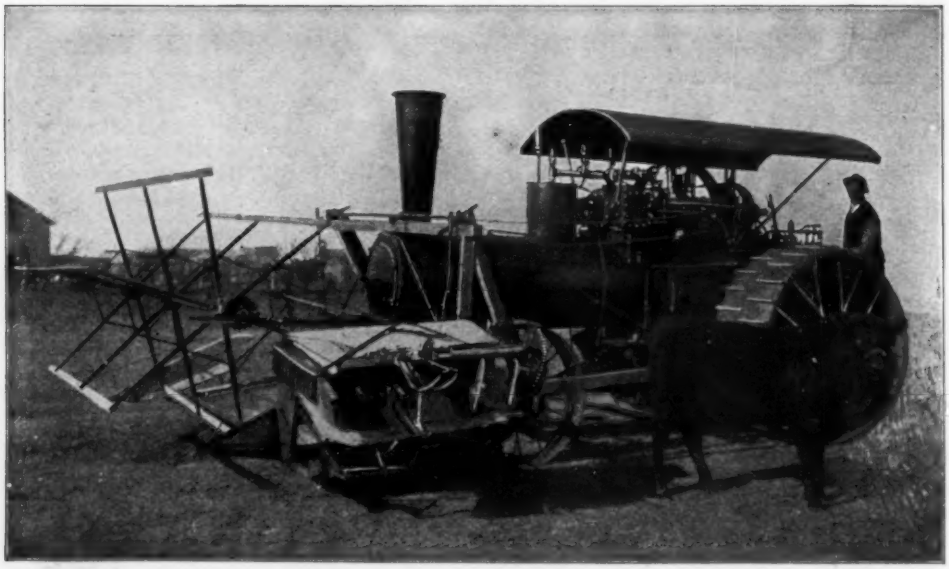
FUEL MADE FROM FLAX.

The refuse from flax straw taken after it has passed through the tow machine, conveyed automatically to the fuel machine by means of a blower, there mixed with crude oil and an artificial binder and then packed into solid blocks 8 by 10 inches in size makes a new fuel that is said to be a great heat producer and 50 per cent cheaper than coal. This fuel was tested recently on a locomotive with satisfactory results. Nine hundred pounds of the new fuel were consumed on two-thirds of the run, whereas the same distance requires one ton of coal. J. T. Smith, the inventor, expects to establish plants throughout the northwest and manufacture the product in large quantities.

SMOKELESS FUEL.

A new fuel, said to consist of coal dust and oil treated by a secret process that renders it smokeless, is to be manufactured by a French company that claims that its product is cleanly, economical and of the best heating quality.

Harvests Crop and Plows Ground at the Same Time



A combined steam harvester and plow that gathers one crop while breaking the soil for the next season, is in use by Wm. Milton, at Stafford, Kansas. The same 16-horsepower traction engine that propels the binder, hauls the twelve 12-inch disk plows, and as the grain falls before the machine the dark furrows trail behind. This combination easily cuts and plows from 400 to 600 acres in a season. The Farm Implement News says it has been a great economizer of time, labor and expense, as well as affording great satisfaction in the double accomplishment of the day's work.

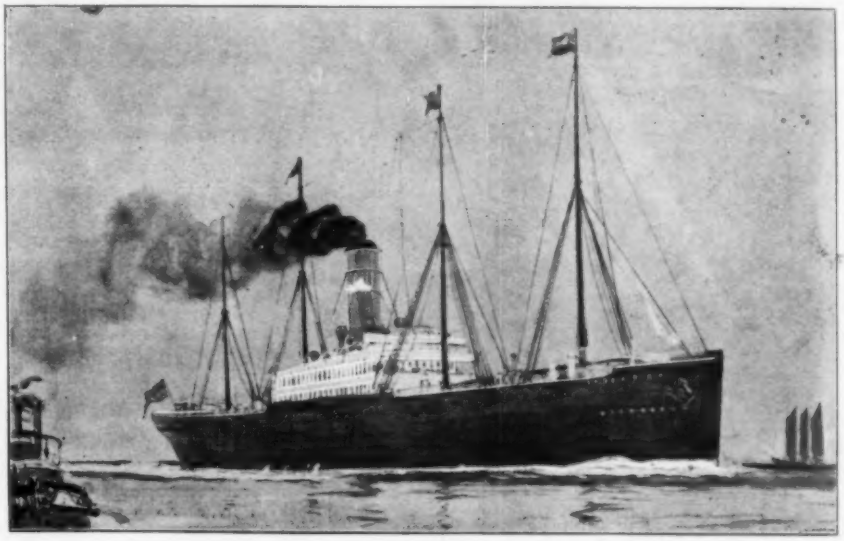
Raised a Brick Building 180 Feet

A three-story brick house weighing hundreds of tons, successfully climbed a steep bluff 160 feet high at Kansas City, without cracking a pane of glass. Upon reaching the top the house was rolled along 300 feet to its destination. It had been built some years ago in a location which was no longer desirable for residence purposes. It was a case of tearing the house down or moving it. The house was carried on a strong framework of timbers, and raised by the turning of 300 jacks divided into 30 groups of from eight to 12 each, from three to five groups being located under each sill. At a signal given by blowing a whistle, one man started at the end of each group and gave each jack in succession one-half turn. After all the groups had been turned another signal was given and the men returned to the starting points, screwing each jack another half-turn and so on back and forth, simultaneously, screwing the jacks so as to raise the building uniformly about one-half inch at each round trip.

Kansas City House-Climbing Feat

THE LARGEST AMERICAN BUILT LINER.

The largest ocean liner ever built in the United States is the Dakota, which was launched Feb. 8th at New London, Conn. The Dakota is 630 feet in length, 73 feet 6 inches in breadth and has a moulded depth



S. S. Dakota, the Largest American Steamer

from keel to upper deck of 56 feet. The displacement on her maximum draught of 36 feet 6 inches is 37,000 tons. The ship has a longitudinal bulkhead fitted its entire length, thus dividing each hold into two compartments, each having a hatch. Each hatch has two electrically operated winches and two steel built booms capable of lifting from 30 to 50 tons.

The Dakota is equipped with triple expansion twin-screw engines and 16 Niclausse water-tube boilers. Her propellers are 20 feet in diameter and maintain a speed of 14 knots at 78 revolutions per minute.

The coal bunkers are arranged above the boilers and incline at the ends so that the coal gravitates through shutes and is deposited on the firing platform. Five of the decks are of steel plating throughout.

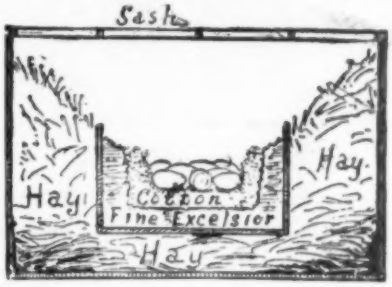
The Dakota will engage in the Pacific trade, running from Seattle by way of Honolulu to Yokohama, a distance of 5,800 miles.

The subject of steel postal cars for the protection of railway postal clerks is being agitated. Many fatalities among the clerks are due to the flimsy construction of the cars in present use.

MAKES HEN HATCH EVERY EGG.

Ideal Hen's Nest Easily Constructed With the Aid of Two Boxes

A hen's nest that will cause the hatching of every egg, if the eggs are all good and fresh when placed, is constructed by a simple process. Secure a large box and a piece of old sash for a cover. Fill half full of hay and bed a small box in the center. Line this with chaff from the hay mow. Inside this put a lining of cotton. Place nine



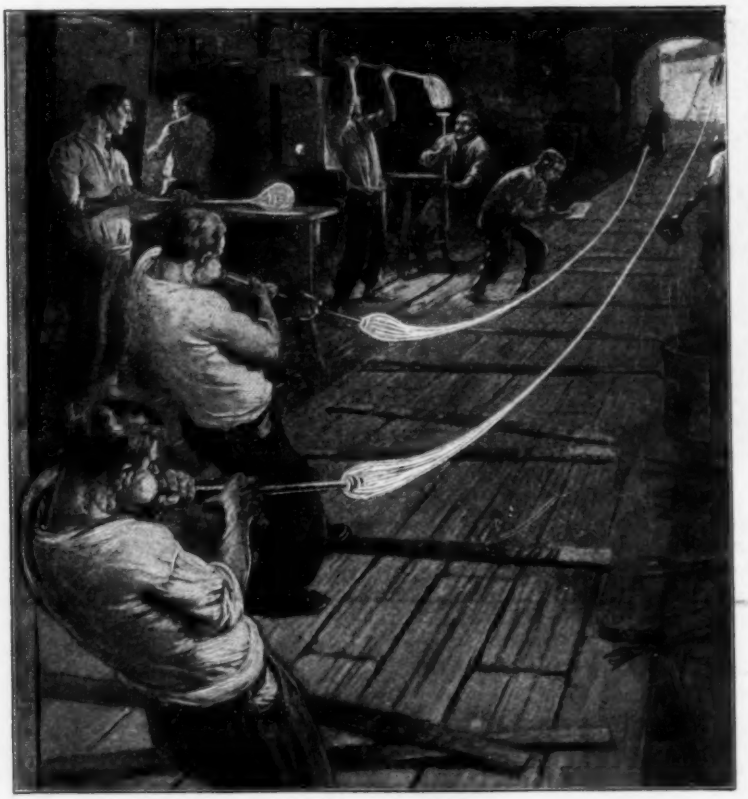
or 10 eggs on the cotton and let the hen enter on her work. The mechanical construction of the nest is illustrated in the accompanying diagram. Remove the hen each day for food and water.

"She has an automobile tongue."
"What do you mean?"
"Why, she's always running people down."

HOW THERMOMETER TUBES ARE MADE.

Few people looking at the fragile little thermometer tubes think or know anything of the process by which they are made, and yet there are few places more interesting than a glass factory.

When the raw material is brought to the factory it goes into clay pots within the crucible and remains there thirty hours at least. When it has become a molten mass it is ready for use. A long blowpipe is thrust into the vivid pool of glass, twirled a moment, and then withdrawn, bearing at its end a small glowing ball. This ball is rolled to a cone on a small slab of iron. Then it is handed to a man seated in a low wooden chair having long arms. He gives a little puff through the pipe, rolls the pipe on the arms of the chair and then it is ready for the master workmen. The blowing requires great skill and the long slender tubes stretch out between the two workers in an incredibly short time. A touch of cold iron severs the glass from the blowpipe and the finished tubes are taken to the annealing oven where they pass by gradation from the intense heat to comparative coolness.



Glassblowers Blowing Thermometer Tubes

NEW RULES FOR THE AERIAL RACES.

Several changes have been authorized regarding the regulations at the coming airship races at the St. Louis World's Fair. Entries will be received until June 1 instead of May 1, as at first announced. The prize for the highest altitude attained has been withdrawn because of the danger in such contests. The minimum speed required in the race for the grand prize of $100,000 is 18⅓ miles an hour instead of 20 miles. The exposition company will furnish free hydrogen gas for all contestants.

Thirty-four entries for the contests have already been filed. Among the contestants are M. Santos Dumont and M. Lebaudy.

The Chicago Record-Herald says: "If some one should enliven the contest by entering an aerodrome or 'flying machine' of the Langley type it would afford a spectacle eclipsing all other attractions of the exposition."

PITS FOR STORING OIL.

Oil burning locomotives are used in California and western Arizona, on the Atchison, Topeka and Santa Fe Railway. Circular pits in the ground, banked up high, the depth being two feet, and roofed over, are used for storing the oil. From these pits it is pumped into small delivery tanks and then run into the engines by gravity. The largest pits hold 50,000 barrels.

IRRIGATION CANAL THROUGH TUNNELS.

An irrigation canal which will pass through three tunnels, the longest of which is 1,400 feet, is now being cut in Nevada.

Entrance to 1,400-Foot Tunnel

The rocky character of much of the country to be traversed necessitated the tunnels.

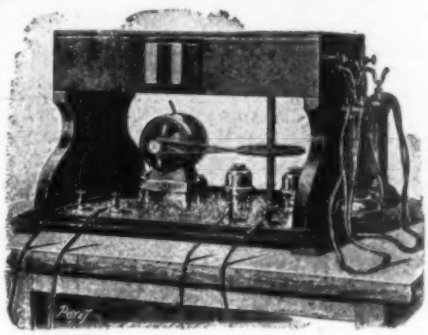
The canal is fed at its source by the Truckee river, whence it passes eastward 14 miles to Wadsworth, Nev., and thence 18 miles to the great "Carson Sink," a desert plain. The canal will be 23 feet wide at the bottom, 53 feet at the top, and 15 feet deep and will receive 1,400 cubic feet of fresh mountain water per second.

About 2,000 men are employed in this work, which will cost the Government nearly $1,000,000. The canal will open vast areas, hitherto arid and waste, to the homesteader and to agriculture, and will greatly promote industries in contingent tracts.

THE PHOTOGRAPHONE—AN ELECTRIC STENOGRAPHER.

The electric stenographer, or photographone is a recent invention that is causing great interest in Europe. The inventor is Mr. Ruhmer, of Berlin, and the first instrument was exhibited before the Industrial Congress at Copenhagen, last month.

With one of these machines attached to his telephone, one can leave his office for hours at a time and return to hear the messages received during his absence. The instrument records upon a thin band of steel the words received by the telephone. By the movement of a lever the impression on the steel band is made to yield the spoken



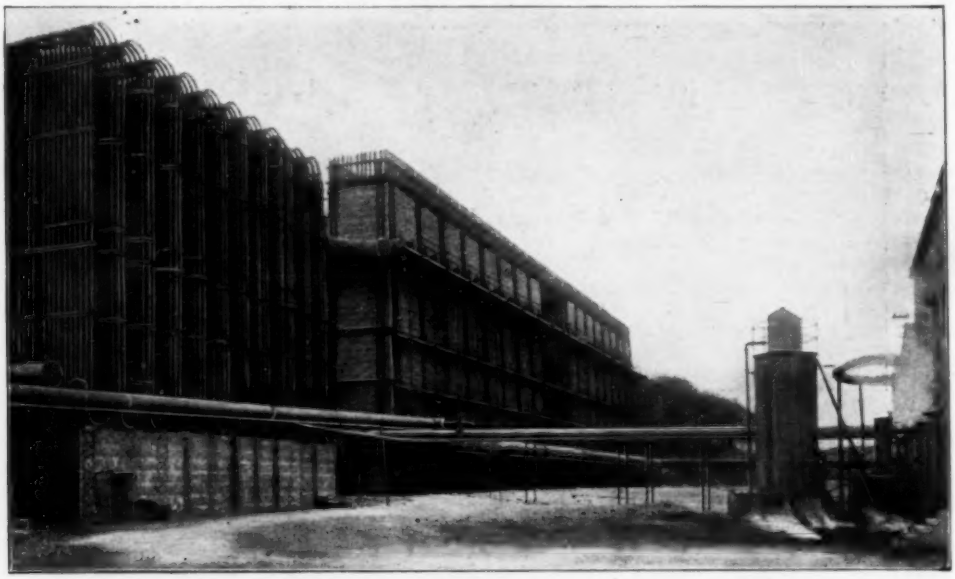
words, which are heard by placing the telephone receiver to the ear.

Gaffney, S. C., is the only place in the United States where tin is mined at the present time. The first shipment from the deposit amounted to 20 tons. The deposit is a continuation of one opened 15 years ago at King's Mountain, N. C., which produced high-grade cassiterite.

A SCOTTISH OIL MINE.

A peculiar industry in Scotland and one which engages much labor and capital is the mining of shale for the production of oil. Great districts are given over to this work, the large somber-looking distillation works scattered here and there emphasizing its enormity.

The shale is mined much after the manner of hard coal. After the shale is brought from the mine it passes through breakers and crushers which reduce the size of the pieces; the ground shale is then conveyed to large storage hoppers at the distillation works, whence it is fed into the retorts. Here the shale is roasted and the gas is drawn off and passed through a large condenser where ammonia and crude oil are distilled off and stored in large tanks.



Distillation Works, Benches of Retorts and Condensers.—Powerhouse on the Right

Naphtha is distilled from the lighter gases after they have been drawn through the fans and have passed through scrubbers. What gas is left is used to heat the retorts. It is interesting to note that the ammonia water separated off is converted into sulphate of ammonia and commands a price of about $65 a ton.

Electricity is being utilized in many of these works with a consequent diminishing of danger, reduction in coal consumption, lessening of smoke and economy of labor.

MISFIT HOSE COUPLINGS AT ROCHESTER.

When Rochester was threatened with destruction a few weeks ago a frantic appeal for help was flashed to Buffalo and other nearby cities. When assistance arrived the outside fire apparatus were for a time useless because the hose couplings which connect the fire plugs to the steamers failed to fit. Water was finally taken from the canal, but great confusion reigned while efforts were being made to connect the hose used by different cities.

The same thing happened at Baltimore, where it is related a New York fireman succeeded in tying a steamer suction pipe to a hydrant nozzle and actually drew water in this manner.

The attention of fire chiefs will now be given to securing some general standard of sizes, connections, and screw threads which will make the fire apparatus of the country interchangeable in time of great disasters. The discovery has occasioned dismay among fire insurance companies no less than among business men and property owners everywhere.

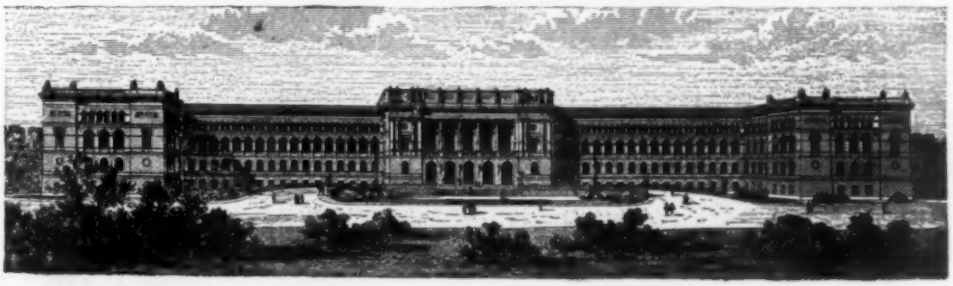
In the United States nearly 13 of every 10,000 inhabitants are studying at colleges of university status. The number in Great Britain is less than five.

Largest Technical High School in the World

The Berlin Technical High School at Charlottenburg is the largest institution of the kind in the world, having 4,378 students, all over 18 years of age. Although it is called a "high school" the work is of an university standard.

Architecturally its buildings are very beautiful, says London Technics. The main building, four stories in height, 750 feet long and 300 feet deep, presents an impressive exterior, only to be surpassed on entering the spacious entrance hall to marvel at its interior.

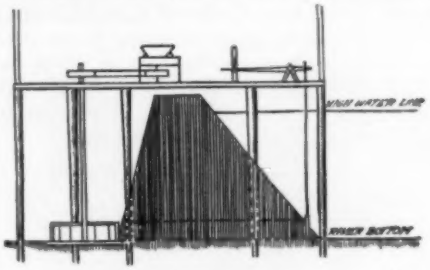
Of the five courts around which it is built, the beautiful central one, glass-covered and surrounded by galleries on every floor, is perhaps the most noteworthy. On the main floor the corridors are a series of double pillared arches and afford a fine view of the great central court or hall. All the corridors are built on the inside, thus depending on the courts for light and ventilation, while the class rooms, offices, museums, etc., are arranged on the outside. Charlottenburg is beautifully located on the main road from Berlin.



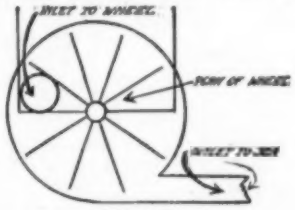
Front of Main Building, Berlin Technical High School

A CURIOUS TIDE MILL.

Vast fortunes have been lost in the attempt to perfect a tide motor which would utilize the limitless power of the flowing and ebbing tides. As long ago as 1800, however, tidal mills were in successful operation in Nova Scotia. These mills were used to grind a coarse oat meal which was generally used in place of flour at that time. The water wheel was ten feet in diameter and made of wood; the sluices were built of blocks of stone four feet long and one foot thick. The wheel was placed in a horizontal position and the shaft carried to the floor of the mill, which was about two feet above the waterline. A belt connected a pulley on the shaft to another on the spindle of the grinding stone. The mill and dam were placed at the outlet of a creek or small river, with gates swinging inward hung in the dam. When the tide ceased to flow and commenced to ebb the gates closed and retained the water. After the tide had gone out the outlet sluice was opened and the mill started. The dams were made of earth with logs embedded to give additional strength. The Canadian Engineer says: "Other mills were used for sawing logs, the reversing gear being operated by separate water wheels."



Side Elevation



Plan of Wheel

CUTTING TREES AND LOGS BY COMPRESSED AIR.

The largest tree that grows, and logs of mammoth dimensions are being swiftly cut down and sawed by means of compressed air. The advantage is that the air compressor, which is operated by a gasoline engine, is portable, being placed upon a wagon and hauled about by one team. From the compressor the air is conducted through hose to the pneumatic engines which work the saws. Compressed Air says the pneumatic engine is capable of making from 125 to 150 strokes per minute, depending on the pressure of air used. At sixty pounds pressure it will develop 2½ horse-power. The engine weighs 50 pounds, being constructed almost entirely of brass and steel tubing. It is claimed for the valve motion, which is of an entirely new design, that it has no complicated valves or parts to get out of order and that it is very simple and easy of adjustment. The frame is made of machine steel and wood and though light in weight is strong and durable.

Pneumatic Saw at Work

The makers declare that one man with one of these machines can easily cut ten cords of 2-foot wood per day, or 50,000 feet in logs, reducing the present labor expense at least 50 per cent.

The pneumatic engine shown in the illustration has a cylinder 2½ inches diameter by 30 inches long.

The compressor can be worked by steam or electric power, if available, or by an ordinary locomotive air pump attached to any logging or portable engine.

TO BUILD A BOULEVARD 1500 MILES LONG.

The famous Old Mission road of California, built and used by the Spanish mission fathers 200 years ago, is to be restored if the plans of the California Automobile Club are carried out. Inasmuch as there are several thousand auto enthusiasts in the state, including countless milionaires from the East who winter on the Pacific coast, there is not likely to be any difficulty in raising the money.

This grand boulevard, 1500 miles in length, of which the route from San Diego to San Francisco is a part, is to be made the finest roadway in the world. The natural scenery is often grand and everywhere intensely interesting. A chain of magnificent hotels is to connect the two cities.

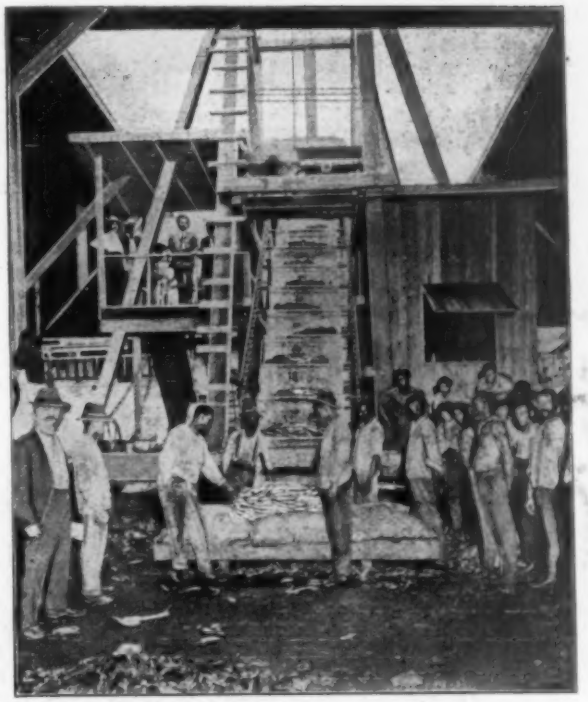
THE TECHNICAL WORLD.

To aid students and others interested in technical knowledge is the praiseworthy mission of the Technical World, a new monthly journal that has just made its appearance in the interest of the Armour Institute of Technology. The Technical World is issued in usual magazine form and contains 112 pages. Its articles are comprehensive, interesting and profusely illustrated. In the initial publication considerable space is devoted to an exhaustive illustrated description of the American School of Correspondence.

BANANAS UNLOADED BY ELECTRICITY.

Electricity is taking the place of African stevedores in the unloading of vessels. The new electrical machine which has been used so far to save labor in unloading bananas is capable of being adapted to other cargoes and undoubtedly in time will take the place of more tedious methods so out of accord with twentieth century progressiveness.

The machine, which is operated by a 15-horsepower induction motor, is built on a platform on the wharf and resembles the carrier of a threshing machine. To unload the vessel one end of the machine is lowered into the hold. The carrier runs up perpendicularly about 30 feet and across to the wharf. The wheels on the platform move on a rail track. The canvas carrier is divided by wooden bars into pockets, each 30 inches long and 48 inches wide. A bunch of bananas is placed in each pocket and the load carried to the wharf in perfect condition and at the rate of 5,000 bunches per hour.



Electrical Machine for Unloading Bananas from a Vessel

The machine is controlled from a lookout tower containing four levers.

RIDES TO FIRES IN AN AUTOMOBILE.

The chief of the Newton, Mass., fire department rides to fires in an automobile. This is one of many recent improvements making the Newton department one of the most perfectly equipped and up-to-date call forces in the United States. The use of the automobile in this line is apt to become general in all those cities where good pavements will permit, its unquestionable advantage over other vehicles as to speed and economy of motive power placing it foremost in cases where these qualities are necessary.

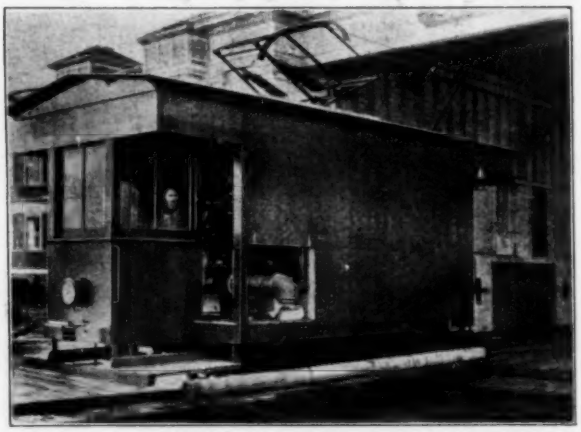
Chief of Newton, Mass., Fire Department Going to a Fire

HOW TO MAKE A BRICK FORGE.

The following is the plan for building about as nice a forge as I ever saw, says a writer in the American Blacksmith. Commence the forge as large as you want it, building it to the height of the bed just as you would any brick forge. From there on continue the forge up six or eight feet, the size of the hearth. Make an opening in front high enough to take in a wagon tire, and wide enough to give room to get the work in. There can be an opening at the back to let the work go through. Taper the forge to three bricks square and run the flue above the building, and you will never be bothered with any smoke or dust in the shop.

TROLLEY FIRE ENGINE CAR.

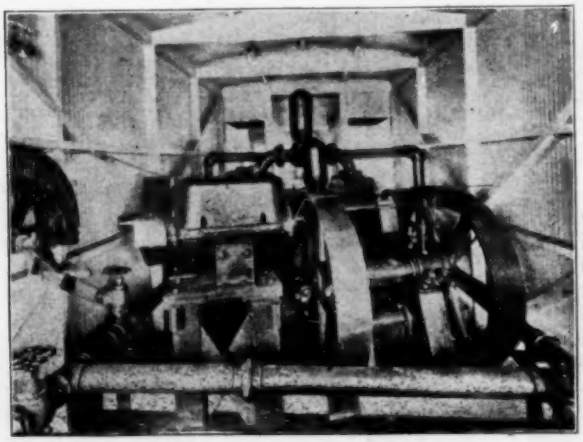
Whenever fire breaks out in any of the numerous docks, depots or other buildings of the Oakland, Cal., street railway, a strange looking trolley car may be seen



Electric Fire Car.

dashing along the street at full speed. The other trolley cars lose no time in getting on side tracks and other streets in order to let the fire car pass. This fire car is unlike any other trolley car in the world, and when its electric pumps are set in motion will throw as much water as the largest fire engine of any fire department. In order to avoid any possible delay from the trolley coming off the wire, a trolley of peculiar construction has been provided. It consists of a bar held in a frame which slides along the trolley wire instead of the usual trolley wheel. The Street Railway Journal says:

"The car is 25 feet long, and 9 feet wide. The pump room is 16 feet long. The fire pump is an 8½ by 12-inch machine, having an 8-inch suction and a 6-inch discharge. A 35-horsepower electric motor operates the pumps. A separate set of motors propel the car."



Electric Fire Pumps.

MATE, THE LATEST DRINK FOR SODA FOUNTAINS.

A new beverage, and one which promises to gain the ascendancy over other stimulating drinks is mate, a food product used for many years in South America and gradually finding its way into the United States and European countries. Experiments have shown it to possess indisputable medicinal properties with after-effects verging on a happy combination of those of opium and of bromo seltzer.

Mate is prepared from the leaves of ilex after the manner of preparing tea, and may be served in various ways.

A Mate Pot.

South Americans suck it from a bowl through a silver tube termed a bombilla, says the Soda Fountain. Mate is a cheap product and if all claimed for it holds true it will be a lamp post for Prohibitionists to lean against.

English manufacturers are sending out a floating exhibition of English goods and manufactures for a trip around the world, taking in many great ports. An American exhibition has been proposed along the same lines and as the United States is now the greatest exporting nation of the world, nothing could be more appropriate.

Send for our Premium List.

SHOP NOTES

HOW TO COLOR ELECTRIC LAMPS.

Very often much effectiveness can be worked out in a window trim with the aid of colored lights. Colored lights are expensive. The following formula will explain how to color electric lamps, thereby saving a big part of the expense. Take a little white shellac, thin it down with alcohol, and by dipping the bulb in this it produces a splendid imitation of frosted glass when a clear white light is required. Care must be taken to have the shellac very thin, otherwise it will not run smooth. If you use green, purple, red, blue or any other color, buy a package of egg dye of the color required, dissolve it in wood alcohol and pour it into the shellac. By using this or any transparent coloring a vast number of beautiful tints can be made that will blend with your color scheme.

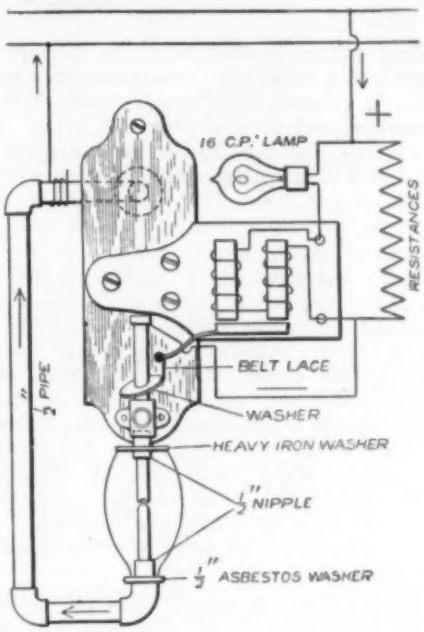
To go about it properly and to get the best results, after preparing your shellac pour it into a vessel deep enough to immerse the lamp. Take a piece of wire and fasten it around the socket of the lamp, then bring one end of wire back over the end of the lamp to opposite side of lamp to form a loop, then dip it in the solution and hang it up to drip and dry. While mixing your color bear in mind that the more dye and the less shellac the deeper the tint will be, and vice versa. Any of these colors can be removed with wood alcohol.

HOW TO MAKE AN ARC LIGHT.

Any engineer can make a cheap, serviceable arc light out of the odds and ends generally found around a plant. We get the following instructions from The Engineer:

"It will be noted in the sketch that the feed machinery is nothing more than the magnets, armature and hammer of an old electric 5-inch bell. The magnets, with a 16-candlepower incandescent lamp in series with them, are connected across a resistance of about 25 ohms, which may consist of three or four coils, taken from an old rheostat or a bank of lamps in multiple. The magnets and the 25 ohms resistance are in multiple and are connected to the positive lead, which is clamped to the top carbon. The negative lead is simply connected to the ½-inch pipe, where convenient.

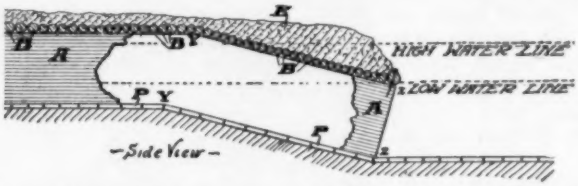
"Sliding loosely on the top carbon is an iron washer with a small hole drilled near the edge with a thin lace passed through it and tied to the end of the hammer. The spring on the armature must be bent so there will be no make-and-break action. As current passes through the magnets, the



hammer pulls on the washer, causing it to grip the carbon and lift it up, thus forming the arc. As the carbon burns away, less current passes through the magnets, causing the carbon to lower and keeping it the right distance from the lower carbon. When the hammer has lowered as far as it will go, the washer on the carbon should be low enough to strike on top of the drop tee, causing it to release its grip on the carbon and allowing the carbon to fall. More current now passes through the magnets and the carbons are pulled apart again, the iron washer having taken another grip. This action is continuous and the lamp can be adjusted, so there will be no flickering in the light whatever."

HOW TO BUILD A FROST-PROOF TAIL RACE.

Users of waterpower who have experienced trouble from freezing the past severe winter, will be interested in a method described in the American Miller which is to prevent trouble. The writer says: Our raceway has a cross-plank bottom from the



wheel pit to a short distance below the mill. The sides are planed timbers, A in sketch, covered with round cedar, B, laid crosswise and covered over with earth. We excavated the last 20-foot section from Y to Z and then carried the bottom on a level a short distance. The remainder of the waterway is open race with earth bottom.

The top of the sloping section, of course, follows the same angle downward from Y to Z as does the bottom and dips into the edge of low water, shutting off all currents of air from outside, but allowing a free flow of the water, which just flows downward under the upper covering and then rises to its original level on the outside, flowing away without having the current stopped or raising the tail water. We made this submerged section of slightly larger capacity by setting the side timbers, A, a little farther apart. But a little more space is sufficient.

Since using this arrangement our wheels have been clear of ice and frost and our drive belts are dry. Previous to this we had our main belt connections covered with frost, the gate rods were often frozen and occasionally the water wheels were solid.

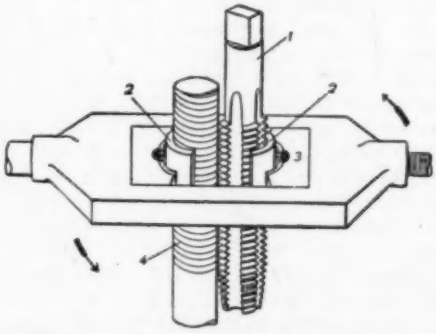
To keep the submerged portion of the tail race from floating we bolted a large log at the outer end and covered the section over with stones and gravel.

FIVE YEAR SUBSCRIPTIONS.

In response to numerous requests the publishers of Popular Mechanics announce a special subscription offer of five years for three dollars. Address may be changed as often as desired.

A THREAD-CUTTING KINK.

Cutting a left-hand thread with a right-hand tap and die is something everyone cannot do, says a correspondent in the Engineer. Referring to the drawing, 1, is a tap which may be of any size, 2 and 2, are pieces of sheet brass or copper placed between the tap and the die and between the bar and die to prevent the crossing of the threads, and to keep the die from tearing out the threads cut by the tap. The tap is right-hand and cuts the left-hand thread. Part, 3, is the die that holds the combination of brass, tap and the iron rod in place while part, 4, is the rod on which the left-hand thread is to be cut.



It may be readily seen that, by placing the combination on the rod as shown and turning the die to the left, viz., in the direction of the arrow, after the first thread is started the rest will follow and will be found to be a perfect left-hand thread.

HOW TO CLEAN AN OIL STONE.

If the stone is glazed or gummed up, try cleaning with turpentine. If this does not restore its cutting qualities, scour it with sandstone and water, or with a piece of sandpaper fastened to a smooth board. Oil or dirt may be removed by boiling the stone in lye, or an entirely new surface may be obtained by holding the oil stone against a grindstone, revolving the grindstone and applying water at the same time.

TO CEMENT LEATHER TO IRON.

A good way to glue leather to iron is to paint the iron with a mixture of white lead and lamp black, dissolved in oil. Then cover with a cement made of the best glue soaked in water until soft, and dissolved in vinegar. This is mixed thoroughly with one-third of its bulk of white pine turpentine, and thinned with vinegar until it can be spread with a brush. It should be applied to the iron while it is hot and the leather put on and quickly pressed into place. It must be held tight by a clamp while it is drying.

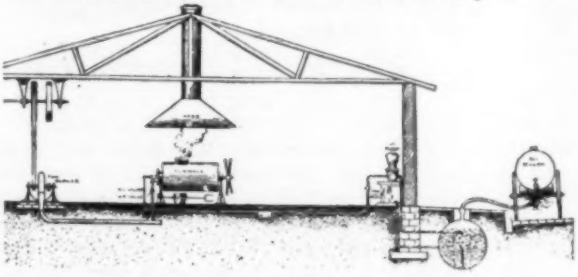
BLOWPIPE METAL WELDING.

At Birmingham, England, a special blowpipe for the seamless welding of steel, iron and other metals has been exhibited. The heat is produced by the burning of acetylene with oxygen, and is so intense that the welded joints show no trace of their welding. The separate gases pass from cylinders through valves which reduce the initial pressure in the cylinder to about 7 pounds on the blowpipe. The united gases are then ignited and though the heat zone is only about one-eighth of an inch in length it melts the metal quickly. Even quartz can be quickly melted, it is said, and blown like glass.

MELTING BRASS WITH OIL FLAME.

One to two gallons of fuel oil will melt 100 pounds of brass. This is done by means of a furnace which, to a degree, has done away with the use of crucibles.

In this furnace the oil fuel is generally



Furnace for Melting Brass

supplied to the burner by a gravity system which consists of an overhead gravity tank with a capacity of 10 to 20 gallons, to which oil is pumped by hand or power from a reservoir tank located conveniently for piping either inside or outside a building, and generally underground. When the gravity tank is placed at a height of 12 feet or more above the furnace a head pressure of five pounds to the square inch is obtained, which is ample for the oil feed. Any ordinary grade of fuel oil may be used for fuel, or, where procurable, crude oil. Natural gas may be used with the same success.

HOW TO PROTECT THE GROUND CONNECTION OF A TELEPHONE.

An excellent way to protect the ground connection of telephones is given in the American Telephone Journal.

Carry the leading-in wire down the out-

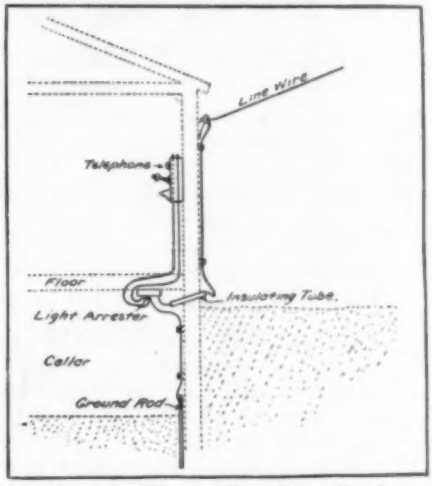
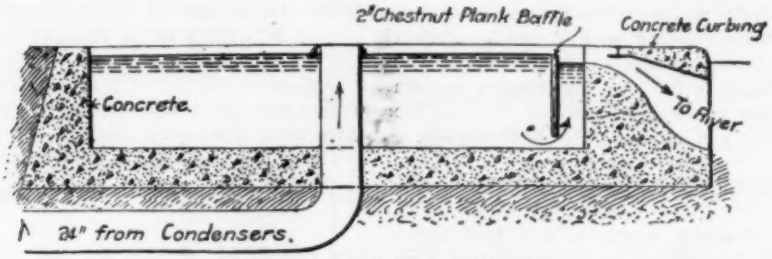


Diagram of Wires for Grounding a Circuit

side of the building and into the cellar as near as possible to the spot where the instrument is to be located; attach it to the combined fuse block and lightning arrester; run the wire up through the floor and attach it to one binding post of the instrument. From the opposite binding post run the wire down through the floor and give a scant half-inch of it a full turn about the binding screw of the arrester; carry the wire the shortest way to the ground rod, to which solder it securely. The ground rod should be not less than one-half inch in diameter and three feet in length. By this method the lightning arrester is placed away from inflammable substances and the security of the grounding connection may be easily tested at any time, besides being protected from the extremes of heat in the summer and cold and frost in winter.

RESERVOIR FOR RECOVERING CYLINDER OIL.

An ingeniously arranged concrete reservoir located outside the walls of a plant and receiving the waste water from the system within, may be used for recovering cylinder oil. The main feature is the exit of the water from the reservoir. The oil rises to the top and the water below it flows under a baffle (in order not to disturb the surface) and over a weir into the river. The oil may be skimmed off as often as the amount requires it.



Section of Reservoir for Recovering Oil.

THE WELDING OF ALUMINUM.

At a meeting of the Faraday Society, London, a paper written by Mr. S. O. Cowper-Coles stated as follows:

"Soldered aluminum joints have proven unsatisfactory, as they will not stand the test of time, because galvanic action takes place between the aluminum and solder. One of the chief difficulties encountered in soldering aluminum other than the formation of oxide, is that a few degrees below its welding point it passes into a pasty or brittle state, and, being a very good conductor of heat, the solder very rapidly cools and freezes before it has time to flow sufficiently. He then proceeded to describe Dick's machine for welding aluminum by the removal of the oxide mechanically, combined with pressure. Reference was also made to Heraeus's process of welding aluminum, which consists in heating the aluminum in a reducing atmosphere until it reaches the pasty stage, when the joint is made by kneading and hammering. Emmé's process, which is somewhat similar, consists in heating the aluminum up to 600 deg. C., and welding by hammering. The electric welding of aluminum has not proved commercially successful."

CARE IN ATTACHING BRASS VALVES.

In screwing iron pipe into a brass body-valve it is necessary to use little or no lead or pipe joint grease, as the brass is softer than iron and gives enough to form a tight joint. If lead or pipe joint grease is used it should be placed on the pipe end rather than in the valve, so that it will not be carried by steam to the bearing parts of the valve and catch and hold scale and grit on the seats and discs of the valve.

Extra long wrenches or tongs placed on the hexagon farthest from the pipe end should not be used for screwing pipe into brass valves, as this method is apt to spring the seats and place them out of line. When screwing pipe into gate and other styles of valves always close it tightly so as to make the body rigid.

PATTERN LEAD.

An alloy suitable for small metal patterns is composed of tin one part and lead one part by weight. The result is a somewhat soft alloy which requires care in the handling of the patterns. Some harder mixtures are as follows:

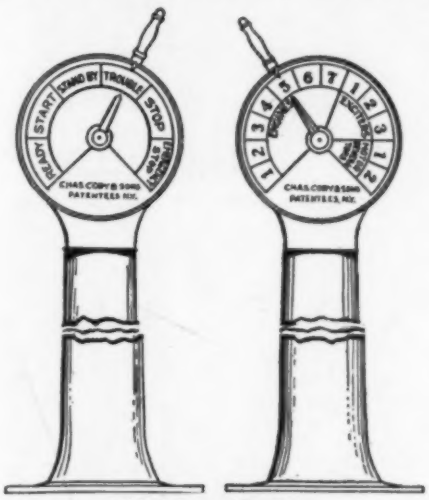
Lead.	Antimony.	Tin.
55	30	15
55	22.7	22.3
61.3	18.5	20.7

A white metal that has small shrinkage and is good for pattern plates is lead 90, antimony 10. A harder metal with small shrinkage and very good for pattern-plates is zinc 66 per cent, tin 34 per cent. The Ironmonger says an amalgam, very convenient for stopping up holes that cannot be soldered easily, is made of the filings of the above alloy, and mercury kneaded in the hand into stiff dough, squeezing out all the mercury possible. This amalgam should be pressed, when first made, into the cavity and allowed to harden. When hard it may be scraped or filed like the metal itself.

SHIP TELEGRAPH SIGNAL SYSTEM FOR POWER PLANTS.

The electric signal system generally used on board ship by which the orders are given to the engineers, has been adapted to the use of electric power plants on land. It frequently is of the utmost importance for the man in charge of the switchboard to communicate instantly to the engineer by means of signals which cannot possibly be mistaken.

The dial in the engine room bears the wording of the usual orders, and when the



Side Telegraph System

operator moves the pointer of his dial to a certain order, the pointer in the engine room instantly responds while at the same moment the bell signal also sounds. The illustration shows a pair of the sending instruments.

A POINTER ON DRILLING IN IRON.

Sometimes it is necessary to drill a hole in iron when making repairs to wood-working machines, and it is found that the drill is just a little too small for the size required. If a flat drill is used, it may be made to cut a hole larger than the width of the drill by grinding the center a little to one side, leaving the radius of one side longer than the radius of the other. If a hole is tapped for a bolt and the bolt is too tight, the threads can be opened by putting a piece of soft metal on one side of the tap and running it through again. Neither method is desirable when one has an outfit of tools, but either may help out in a pinch.

CENTER FOR SCRIBING CIRCLES.

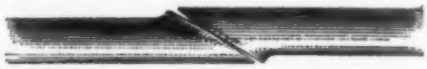
A center to support one end of the dividers while scribing circles is made as follows: Take a piece of hardwood and set into one

of its edges a piece of tin or other metal to receive the prick punch mark for the divider point. This is handy in working at large core boxes when scribing circles on the ends.

SCARFS FOR WELDING STEEL.

A correspondent from New Zealand who has success in welding steel tells how it is done there:

For the last six years my work has been principally working steel of various grades. I get my steel I am going to weld and upset the ends of each piece scarf them with a short scarf, seeing that my scarf is full in the center so that when they come together they will touch in the center first, so that all dirt, etc., will squeeze out sideways, as the welds come together. I then make up a good coke fire, place my two pieces of steel in it and get my helper to blow very steadily until my steel gets thoroughly heated through, and then the last few seconds I get him blowing very hard. My helper takes one piece and I take the other and give them a few light taps over the anvil to remove as much dirt as possible. I stick it first with my hand hammer, then



get my helper to give one or two light pressing blows, and then heavy and as quick as possible. I have welded from ½-inch to 2-inch steel and very rarely had to take a second heat. The flux I use is sandstone or sea beach sand, and it has always given me perfect satisfaction. I have welded steel drills for rock boring machines and hammer and drill steel, and very rarely have had one break in the weld.

I have seen men rivet steel for the rock boring machine and have noticed that they break where the rivet goes through. I think it is impossible to get a solid weld when rivets are used. I am inclosing a sketch to show how the scarfs are made.

ELECTRICAL EXPRESSIONS AND THEIR EQUIVALENTS.

The Practical Engineer publishes a table of electrical expressions and their equivalents, arranged for convenient reference, as follows:

One WATT	A RATE of doing work	
	1.	ampere per sec. at one volt
	.7373	foot-pounds per second
	44.238	foot-pounds per minute
	2654 28	foot-pounds per hour
	.5027	mile-pounds per hour
	.00134	Horse-Power
	$\frac{1}{746}$	Horse-Power
One KILOWATT	A RATE of doing work	
	737 3	foot-pounds per second
	44238.	foot-pounds per minute
	502.7	mile-pounds per hour
	1.34	Horse-Power
One HORSE-POWER	A RATE of doing work	
	550.	foot-pounds per second
	33000.	foot-pounds per minute
	375.	mile-pounds per hour
	746	watts
	.746	kilowatt
One WATT-HOUR	A QUANTITY of work	
	2654.28	foot-pounds
	.503	mile-pounds
	1.	ampere hour per one volt
	.00134	Horse-Power-Hour
	$\frac{1}{746}$	Horse-Power-Hour
One HORSE-POWER HOUR	A QUANTITY of work	
	1,980,000.	foot-pounds
	375.	mile-pounds
	746.	watt-hour
	.746	kilowatt hour
One AMPERE HOUR	A QUANTITY of current	
	One ampere flowing for one hour, irrespective of the voltage	
	Watt-hour volts	
TORQUE	FORCE moving in a circle	
	A force of one pound at a radius of one foot	

HOW TO WORK STEEL INTO TOOLS.

A blacksmith, successful in working steel into tools, thus describes his method in the Mining and Scientific Press: The steel is worked at an orange heat during the forging. When shaped, the next step is refining. This is done by hammering in water. A little water is put on the anvil and the face of the hammer is wetted. The steel must be at nearly red heat when this is done. The refining is repeated by reheating several times. After finishing this, the steel is heated to a dark red, so that it just shows the color, and dipped in raw linseed oil. The tool is reheated and dipped three times. The fourth time the reheat is carried to an orange color and dipped in the oil until nearly cold. The oil is then wiped off and the metal polished, care being taken not to break while polishing, as the metal is extremely hard. A large piece of iron is then heated to a red heat. The tool is laid on this with the heavy side down to draw whatever color is desired, different tools requiring different colors.

WATER PUMPED FROM GASOLINE STORAGE TANK.

Water instead of gasoline was pumped from a large gasoline storage tank at Cleveland, Ohio, recently. The tank had had gasoline emptied into it several weeks before. Investigation showed that the tank was affected by frosts and thaws, that moisture collected on the sides and bottom and the gasoline being lighter than water rose to the top, making it necessary to pump the water out first. Tanks made of galvanized iron well coated with tar will not sweat.

THE WATT.

The watt, the unit of electrical power, is 1-746 of a horsepower. It equals the mechanical energy represented by 44.24 foot pounds. One ampere of current moving under the influence of one volt pressure, or any combination of volts and amperes, and that will make unity when multiplied together, is the equivalent, in the expenditure of energy to the work a man would do in lifting one pound 44.24 feet high, or any work—any weight—raised any distance, in which the weight and the distance multiplied together make 44.24.

CORRECTING BLUE PRINTS.

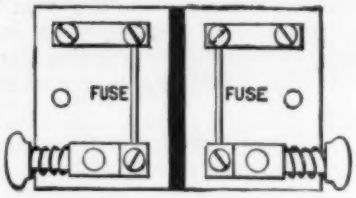
Lines omitted on a tracing can often be produced on the blue print by scratching through the blue surface with a sharp-pointed knife. If carefully done, says the American Machinist, the resulting line is much better than one made with erasing fluid.

CARE IN BURNING OIL.

In firing with petroleum, if the fire should go out, as it sometimes does when water is mixed with it, the oil continues to spray onto the hot furnace, generating a gas. If you attempt to light the fire the gas will explode with violence, says the Mining and Scientific Press. First shut off the flow of oil, then blow the gas up the smokestack, then you can light the fire with safety. Never venture near a barrel or other vessel which has the petroleum in it, with a naked light, as it is liable to have gas in it, and is more dangerous than when full of petroleum.

CONVENIENT CONNECTOR FOR TESTING.

A very simple and convenient connection for testing wires is illustrated in the London Electrical Review. It is intended for use on currents up to 10 amperes, and is easily constructed.



The square plunger is kept out a certain distance by a spring, and on pressing the ebonite knob, the two holes come into line. By inserting the wire and releasing the knob, the spring causes a fair grip of the wire. The edges of the holes being well rounded, quite small wires can be clamped without being cut. A pair of fuses protect the terminals.

TO CUT ENDS OF STEEL TIRES.

I have a simple way of cutting off ends of steel tires, or any iron, with the aid of a helper, writes J. L. Painter in the American Blacksmith. I take a heavy three-cornered file and break it up into 2 or 3-inch lengths, and draw the temper, when they are ready to use. I lay the file on the anvil and place the tire on top and have the helper strike, after which I turn the tire, give it another blow and off it comes.

SIMPLE DEVICE FOR MAKING COIL SPRINGS.

A contributor to the American Artisan tells of a simple device for making coil springs:

"Take a piece of band iron about 12

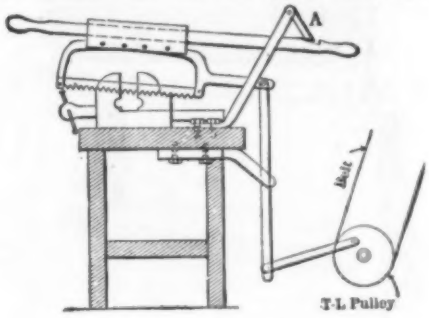
inches, 1 inch wide and ⅛ inch thick, turn up the ends as shown in the sketch, bore holes for the crank and bore holes in the end of the crank to receive the end of the spring wire. It can be fastened to the bench with screws or held firm in the vise."

HOW TO MEASURE COAL IN A BIN OR BOX.

A solid cubic foot of anthracite coal weighs about 93 pounds. When broken for use it weighs about 54 pounds. Bituminous coal, when broken up for use, weighs about 50 pounds. The consequent rule for the approximate measurement of coal in a bin or box is to multiply the length in feet by the height in feet, and again by the breadth in feet, and this result by 54 for anthracite coal, or by 50 for bituminous coal. The result will equal the number of pounds; and to find the number of tons, divide by 2,000.

A HOME-MADE POWER HACKSAW.

I send a sketch of a home-made power hacksaw; it is not very pretty, but it gets there just the same, writes a correspondent to the American Machinist. There is not much machine work about it, as can be seen. It is secured to an ordinary machinist's bench and all the parts are made



HOME-MADE POWER HACKSAW.

from stock wrought iron, with the exception of the slide which is brass, riveted to the blade frame. For holding the work an ordinary vise is used. The saw is not automatic, but a simple stop at A prevents the saw dropping after cutting through the work. When the apprentice has nothing to do, this is a good thing for practice.

REMEDY FOR VITRIOL BURNS.

A Frenchman has discovered a remedy instantaneous in its effects for the horrible burns caused by the use of oil of vitriol. It is soft paste of calcined magnesia and water, with which the parts burned are covered to the thickness of an inch. It alleviates the pain almost immediately, and when the paste is removed no scar remains.

TO MEASURE TAPERING LOG.

As to the number of board feet in a stick of timber four by four inches at one end and eight by eight inches at the other, the stick being 24 feet long, there are two ways of arriving at a correct answer, says Mining and Scientific Press. Add the areas of the two ends to four times the area of the center section and multiply by one-sixth of the length; or, multiply the areas of the ends and extract the square root; to this add the areas of the two ends, and multiply by one-third of the length. The answer by either process is 74⅔ feet.

A SAW HORSE FOR TINNERS.

"The 'tinner's saw horse' is a model of convenience." It is made by fastening the rolls, folders, etc., to a wooden horse, like those of the carpenter's saw horse. The top and back of the horse should be as

Convenient Saw Horse for Tinners

wide as the base of the machine, and the legs made of 2 by 6 timbers, tapering toward the bottom. The inventor claims that they are convenient to approach with large and odd-shaped work; when wanted they can be brought out into a convenient place, and when not in use may be set aside in a corner or other small space.

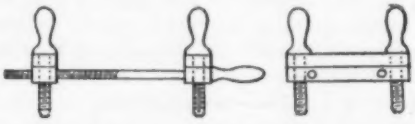
TREATMENT OF BURNS FROM HOT WATER OR STEAM.

When a man is burned with hot water or steam of course the first thing to do is to send for medical assistance, but in the interim the injured man's clothing should be removed, and bandages soaked with sweet oil and lime water should be lightly applied to the burned parts. If steam has been inhaled, sweet oil should also be swallowed by the patient in considerable quantity, as it will soothe such of the burned parts as it can reach.

Sweet oil and lime water should be kept about every steam plant, to provide for contingencies of this sort. Cooking soda (saleratus) is also very soothing when applied to burns, and castor oil in moderate quantity may be given internally in the place of sweet oil.

HANDY BELT CLAMP.

A wooden belt clamp can be made by anyone having a wood screw box and tap. It is very handy in splicing new belts, and old ones can be mended without removal from the pulleys. The writer says: "An



8-inch belt is about the limit of its use, although if you have 1⅛-inch good hickory screws, and leave the handles flat, you can turn them up with a wrench for a pretty stiff pull. I have two clamps, one for wide belts and the other for narrow, with screws long enough so that I can make a glue splice between the jaws when desirable."

TO CLEAN SPONGES.

To clean old sponges, boil them for three or four hours in water (enough to cover them) containing a couple of tablespoonfuls of carbonate of soda, or in water mixed with a couple of handfuls of wood ash, this to remove all the greasy matter that the sponges may contain; then rinse them thoroughly, squeezing them well in several lots of clean cold water. After this preliminary operation soak the sponges in chloride acid, mixed with four times the quantity of water, suiting the whole amount to the size of the sponge, but keeping the same proportions. After 24 hours let water run on to the sponge for some time, then rinse with the hands until the smell of the acid has disappeared. Hang the sponges up to dry over a hot stove, and when this has been satisfactorily accomplished, the sponge will be almost as good as new.

NEW GOVERNMENT SUCTION DREDGES.

Suction dredges, that suck up the mud and debris from the bottom of the river or harbor and deposit it in immense bins, are to be placed in service in different waters of the country by the United States government. Ten such dredges are now being built. Two will be sent to the Great Lakes; two to the Mississippi river; two to Charleston, S. C.; one to Galveston, and one to Savannah, Ga.

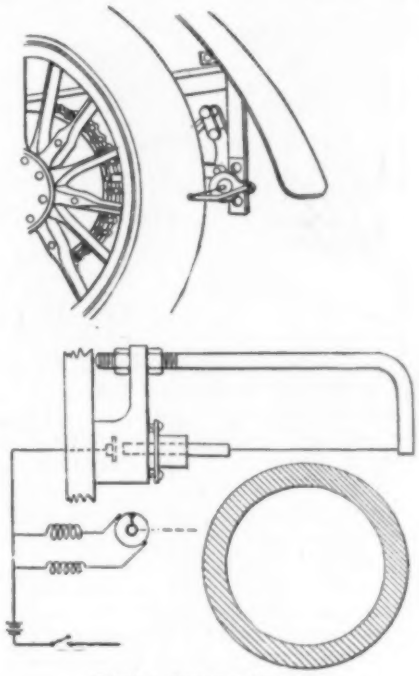
These dredges are the largest in capacity ever built and are designed in each case for the special work. They are self-propelling, sea-going dredges and do not depend upon the assistance of tugboats or other craft to move them around. When the bins in which the dredged material is deposited are full the vessel propels herself out to deep water, dumps the sand or mud and steams back to repeat the operation. Some of the dredges are arranged for depositing the dredged material into large scows fastened alongside the vessel.

The operation of the suction dredges is very interesting. A long flexible tube 12 to 15 inches in diameter drops down from the side of the vessel 20 or 30 feet or more to the bottom of the river or harbor upon which the dredging operation is being performed. The upper end of this tube is connected to an immense rotative centrifugal pump revolving at several hundred revolutions per minute and capable of handling many hundreds of tons of water per hour. The lower end of the tube is manipulated from the vessel against the sand bars and mud banks and as the water is sucked upwards by the centrifugal pumps a very large proportion of sand and mud goes with it. The centrifugal pumps discharge this water with its suspended material into the tanks on board the vessel or into scows, where the heavy matter quickly settles to the bottom, the water flowing back into the sea.

The mechanical equipment of the dredges for salt-water service will include surface condenser outfits. The dredges for the Great Lakes are provided with very large cross-compound, double-acting, air pumps and jet condensers with the usual complement of vertical duplex feed pumps, fire pumps, etc. The air pumps are of a very novel arrangement, inasmuch as it is possible by the manipulation of valves and cocks provided for the purpose to cut each pump in half and run one side entirely independent of the other side. This practically provides a spare pump in each installation without the necessity of being overweighted with two duplicate machines, and at the same time secures the advantages of compound steam cylinders.

ELECTRIC PUNCTURE PREVENTER FOR AUTOS.

When equipped with a recent English invention, an automobile is stopped the moment a nail or other sharp object is picked up by one of the wheels. Inasmuch as a tire is seldom punctured with one revolution of the wheel the device is calculated to prevent accidents of this kind. A fine wire is placed close to each wheel in such a way



Electric Puncture Detector

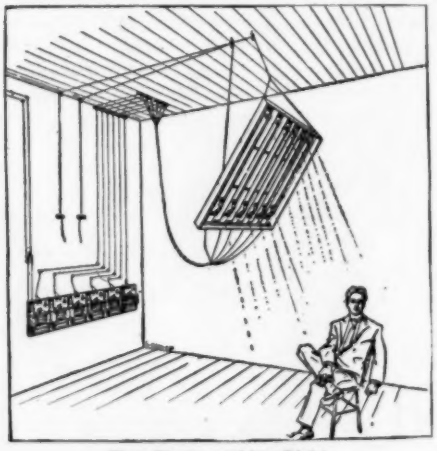
that the moment the obstacle is picked up, says the Motor Age, the wire is broken, which releases a plunger and thus in turn cuts out the current supplying the sparking device when of course the machine stops automatically.

The total power generated and used by the St. Louis world's fair will be in the neighborhood of 50,000 horse power. Over 80 per cent of the electric energy will be in 6,600-volt, three-phase, 25-cycle current.

PHOTOGRAPHER ABANDONS SUNLIGHT.

It is not so very many years ago that photographers turned customers away on cloudy days, telling them it was impossible to secure a good picture. Now one of the leading photographers in New York city has abandoned sunlight, or at least the kind which prevails in a large city, and has shut it out of his establishment entirely and put in a system of his own by which he takes better pictures at midnight than he formerly was able to do at noonday.

The use of the flash light, and electric light in taking photographs is by no means



New Photographing Light

new, but the one is used only for emergency work where the exposure must necessarily be short and natural light impossible; such as a large banquet party for instance. Very fair work has been secured with arc and incandescent electric lights, and engravers who use the photographic process now work entirely with electric arc lights instead of sunlight. Such has been the progress in the art that the exposure of one one-hundredth of a second on a cloudy day, or a thousandth part of a second on a bright day will produce with quick-acting plates excellent results; while pictures taken, developed and printed, all at night, absolutely sun-less photographs, are common.

But all these possibilities have heretofore lacked the necessities for artistic lighting. The flash lights often make people look like lunatics, and the electric light effects have been mechanical. "The new light is really an electric light," says Photo Beacon, "working through the fusing agency of mercury—a form of Crooke's tube."

The inventor says: "I am enthusiastic about it and believe that nothing which has been discovered since the advent of the dry plate, twenty-five years ago, will so revolutionize photography, especially portrait photography, as will this light. It is an epoch-maker."

FUEL ALCOHOL FOR AMERICA.

Proposed Law That Would Be of Wonderful Advantage in Our Commerce

At last America has awakened to the importance of ethyl alcohol for manufacturing purposes, and Congressman Henry S. Boutell of Illinois has introduced a bill in Congress providing for the manufacture and sale of the alcohol free of tax. Germany has found denaturized alcohol a strong commercial competitor of coal, and it has entered conspicuously into all the manufacturing industries of that country. Recently an alcohol exhibition was given at Berlin (reported in a previous issue of Popular Mechanics) at which the numerous and varied uses of the fuel were demonstrated. In propelling light vehicles and running small engines the alcohol has been found superior to any other fuel. It is used for cleaning, cooking, heating, lighting and numerous other purposes to wonderful advantage. In 1902 Germany produced and consumed 58,632,840 gallons of untaxed denaturized alcohol. The use of this fuel has enabled Germany to successfully compete with the United States in many industries previously controlled by this country. Germany's success with the fuel long since caused England and France to emulate her example, and if the Boutell bill is passed the United States will be given an equal chance in the race for the world's commerce, and a new and important industry will furnish a new source of heat and power for many manufactories and various industrial, amusement and domestic purposes.

DEAD SEA'S ONLY BOAT.

Navigation on the Dead Sea is neither extended nor remunerative. There is just one boat there and that is a little sail boat 20 feet long. When adverse winds blow the sea is lashed into indescribable fury. The authorities will not consent to a steam tug being put on the sea, although there would then be considerable traffic, which now goes around the sea on pack trains.

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BOOK REVIEWS.

MY AIR-SHIPS, by Alberto Santos-Dumont. 12mo, 400 pages; 75 illustrations. The Century Co., New York. Price, $1.40. This book tells in an entertaining manner of the Brazilian aeronaut's many daring ascents and descents, of accidents and successes. His airships seem to assume personalities and one follows them with increasing interest. One chapter discusses the possibilities of the air-ship in war. Seventy-five photographs and diagrams and a most appropriate cover design add much to the book.

ENGINEER'S ARITHMETIC, by Fred H. Colvin and Walter Lee Sheney. Pocket size, 125 pages. The Derry-Collard Co., New York. Price, 50 cents. This book is not intended as a complete guide to engineering, but to give the foundation principles of such calculations as an engineer is likely to need. It gives a number of valuable tables and a glossary of terms, also rules for horsepower, boilers, etc. It is written in the simplest manner and may be easily understood, and therefore is well adapted to the needs of the stationary engineer.

COMPENDIUM OF DRAWING, compiled from the courses of the American School of Correspondence at Armour Institute of Technology, Chicago. Two volumes; 900 pages; 1,000 illustrations. Price, until June 1, $3.00 per volume; $5.00 per set. Regular price, $5.00 per volume; $8.00 per set. Part I. deals with the architectural or artistic side of the subject and covers Mechanical Drawing, Shades and Shadows, Perspective Drawing, Pen and Ink Rendering and Architectural Lettering. Part II. deals with the mechanical or practical side and includes Working Drawings, Mechanism, Machine Design, Sheet Metal Pattern Drafting, and Tinsmithing. Each section is followed by the Examination Questions of the American School of Correspondence. The great value of this work is in its clear treatment of each section, its many illustrations supplementing the text. The section on shades and shadows brings the contrasting methods clearly before the eye and enables the reader to locate his own faults in this line. While the first volume attracts more interest the second is more valuable for general use and practical purposes.

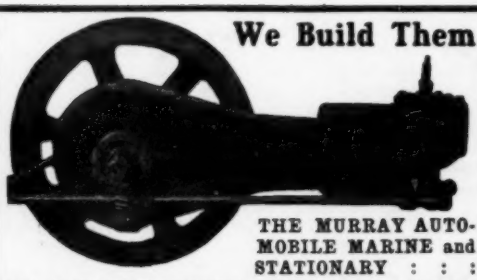
Steam and Electrical Engineering, by E. Spangenberg, M. E., Albert Uhl, A. I. E. E., and E. W. Pratt. 672 pages; 648 illustrations. Geo. A. Zeller, St. Louis, Mo. Price, $3.50. This book is designed to cover the ground of Steam and Electrical Engineering completely, and in a manner making it valuable either as a reference or text book. It contains 1,035 questions and answers.

P. M. POPULAR.

"Popular Mechanics is still popular as you will see by the following list of 14 yearly subscribtions which I obtained in a few hours," writes Sydney J. Staple of Lead, South Dakota.

HOW TO KILL GERMS IN CLAMS.

Clams are a nutritious food, but it has lately been demonstrated that they contain typhus bacilli, which make them highly dangerous unless they are properly steamed. If three layers of them are cooked by steam, the lower layer should be steamed 10 minutes and each of the two upper layers 15 minutes. This kills the bacteria and is the best way to prepare the clams.



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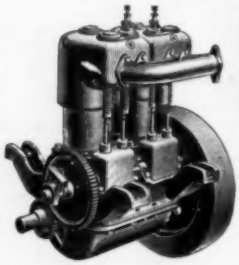

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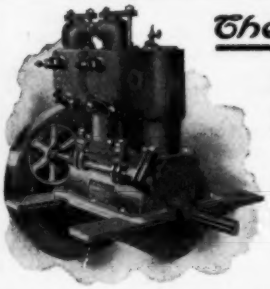

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Watch old Ivan Blowski as he sounds the bugle call,
Turn the picture of Japan aroundsky to the wall;
Let no Japanese escape, but shooteroff them all,
While we go marching through Korea!

Hurrahsky! Hurrahsky! We prithee watch our smosky!
Tigeroff! Tigeroff! If we let one blokesky
Get away alive and safe I only hope we chokesky.
While we go marching through Korea!

—Milwaukee Sentinel.

PRAISE FROM SAN FRANCISCO.

The San Francisco Examiner says: "The current number of Popular Mechanics, perhaps the most progressive and interesting publication of mechanical and inventive progress in America, explains for the first time the mechanism of the electric Post, the most interesting system of rapid transit letters and parcels by electricity."

FREE WHARFAGE AT ST. LOUIS.

Yachts, launches and houseboats have been granted free wharfage space along the river front during the World's Fair by Joseph P. Whyte, harbor and wharf commissioner, acting for the city of St. Louis. The concession lasts during the seven months of the exposition. The circular reads, in part, as follows:

"Yachts and steam launches.—Yachts, steam launches and all boats propelled by their own power will be assigned wharf space between Chouteau avenue on the south and Biddle street on the north. No charge will be made for wharfage.

"Houseboats.—Houseboats will be assigned wharf space north of Biddle street and also south of Chouteau avenue. No charge will be made for wharfage.

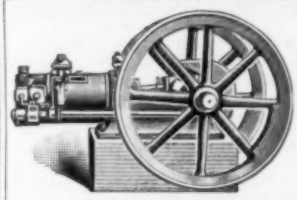
"Applications for Wharf Space.—Application for wharf space should be made to Joseph P. Whyte, harbor and wharf commissioner, city hall, St. Louis.

"Telephone Service.—Free telephone service will be furnished to visitors at the harbor office, foot of Market street."

Boat clubs of St. Paul, Minneapolis, Winona and other up-river cities have projected trips to St. Louis by water. A number expect to use their vessels as hotels during their stay.

MARRIED BY NINE DRINKS.

A peculiar wedding ceremony took place at Berkeley, Cal., recently, between a maiden just over from Japan and Sakio Makino, proprietor of the Dwight Way Belle Nursery. The bride and groom were each ushered into separate darkened rooms where each drank three cups of wine three times, thus becoming, after the Japanese custom, man and wife.



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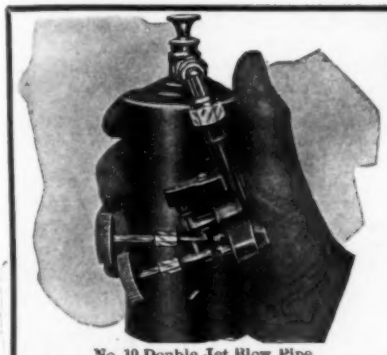

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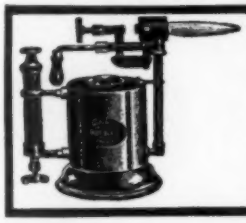

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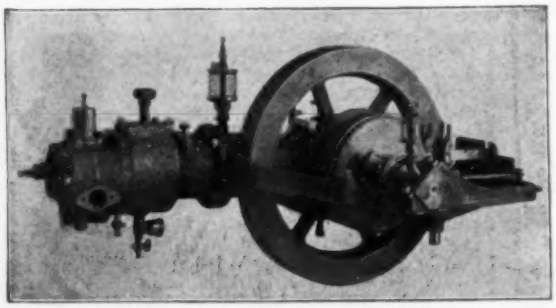

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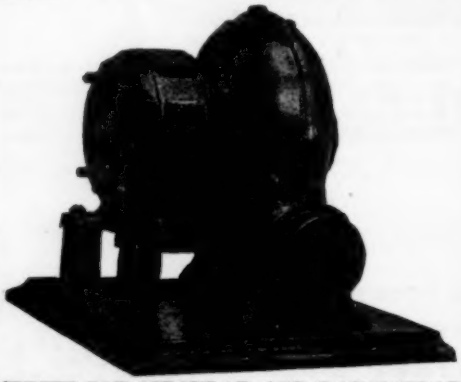

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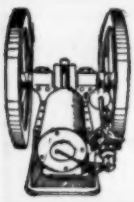

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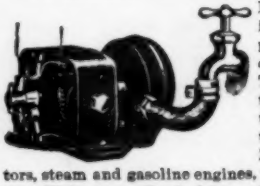

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(Based on a Philippine Incident.)
Man named Rafferty—Needn't laugh;
No one said the name was Greek,
French or German. Stow the chaff!
Here's the word I wish to speak:
At the ambush of Kenire
Hell broke loose, with sulph'rous glare;
All the heights were ringed with fire—
Man named Rafferty was there.

Man named Rafferty—Here the pass
Grew so narrow, rock bestrewn,
That the winds, in surging mass,
Shrieked for aye an eerie tune.
Straight ahead the demons came,
Yelling, howling, in their wont,
Till we blocked their hellish game—
Man named Rafferty in front.

Man named Rafferty—"Be me sowl,"
So he said, "jist wan man can
Howld thim divils that wud prowl
Afther blood, and—Oi'm the man.
Rin yez sphalpanes! Niver fear;
Oi wull kape thim, do yez mind."
Well, we ran, for life is dear—
Man named Rafferty behind.

Man named Rafferty—No one knows
Just how long he held the pass
'Gainst that horde of grimy foes,
Ere they crushed him, mass on mass,
But he saved us in his fall;
Loyal heart, and brave, and true—
Grace of God, surpassing all,
Man named Rafferty, for you.

—Sunset Magazine.

MIKADO JUST LIKE A MORMON.

Mutsuhito, the emperor of Japan, would be called a Mormon, if he lived in America. He has nine wives, one of whom is the empress and eight are consorts, having no social rank and not figuring in any way in the court ceremonies. They were selected for him by the imperial council from among the first families of the nation. William E. Curtis in "The Yankees of the East," says of them:

"They seem to be a sort of guaranty that there shall be an heir to the throne as their children are recognized as of full standing in the royal pedigree, and the present heir apparent is the son of one of them. They are selected because of their pure blood, their health and beauty and sometimes for political reasons, for it is considered the highest distinction that can be conferred upon a woman in Japan—to be empress is nobler only. The left handed wives of the emperor often wield a tremendous influence, for obvious reasons, and their relatives are supposed to profit thereby. They live in the greatest luxury, are surrounded by multitudes of attendants and except for their omission in the court codes of etiquette, they stand equal to the empress herself."

The book states that the emperor has had 12 children, of whom only four, three girls and one boy, are living. The Countess Sono was the mother of four children, the Countess Chigusa and the Countess Yanagiwara of three each and Mme. Hashunato and Mme. Hamuro of one child each. Woshito, the prince imperial, is the son of Countess Yanagiwara. Before her marriage the empress of Japan was Princess Haruko. She was married at 19 and is two years older than the emperor. She has had no children. The noblemen and wealthy men of Japan also have many wives each and it is considered perfectly proper to marry them from among the lowest women of the nation.

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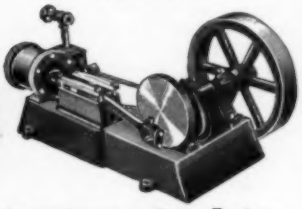

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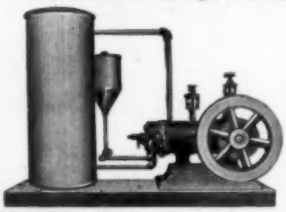

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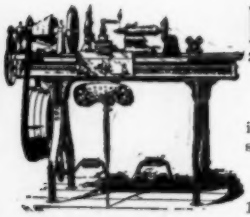

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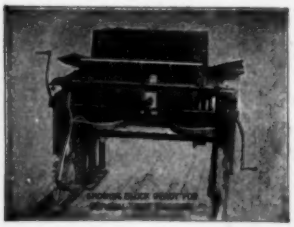

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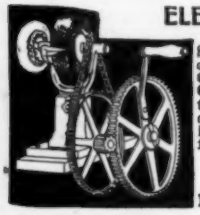

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HOGS SKINNED INSTEAD OF SCRAPED.

Yates county, New York, has started the custom of skinning hogs and it has proved so satisfactory that the old method of scalding and scraping has been done away with nearly altogether in that county. There are no packing houses in Yates county, and the hog skinning is done by the village butchers, entirely relieving the farmer of this formerly arduous task. The butcher charges no more for the work of killing, skinning and cleaning the hog than to be permitted to retain the hog skin.

E. C. Gillett, a resident of Yates county, writes: "The practice of skinning hogs has grown and spread in this county until not more than 10 per cent of all the butchering done is by the old-fashioned way of scalding. Thirty years ago hog-skinning was practiced by only one man in this county and that on a limited scale. The demand for his services increased so that he was obliged to take a partner, and yet another, until now there are dozens of men who make it a sole business for six or seven months of the year. The butcher takes the skins for pay and they are worth from 50 cents to $1.00 each. It is remunerative business. From the standpoint of the owner of the hog it is a good thing, too. Before the advent of the skinner a big iron kettle had to be procured in which to heat the water, a hogshead or tub in which to scald the porker, a platform built on which to lay the animal while the hair was scraped off, the water carried and heated to the boiling point. These preparations took the best part of the forenoon. If the hogs were large and heavy, or there were many of them to kill, help had to be secured from a neighbor, and that meant extra meals for the good housewife to get, besides the work of cleaning the fat from the stomach and intestines, which always used to fall to woman's share of the butchering.

"Now, the butcher will drive into the yard, catch, kill, skin, clean the inwards and hang up a half dozen hogs in two or three hours. There is no water to heat, no mess to clean up, no extra help to hire and feed. The loss in weight is slight, from five to 15 pounds, according to the size of the hog, but the butcher will pay half a cent more per pound for pork skinned to cut up on the block and for home use it is decidedly better. This practice seems to be only local, for the secretary of the State Grange told me not long since, that he had traveled all over the State, but he never heard of such a thing as skinning a hog outside of Yates county. There is a good opening in every section for a butcher to take up this business. It might take a little time to educate the people to it, but not nearly so long as it would to induce the people of this county to revert to the old practice of hog scalding."

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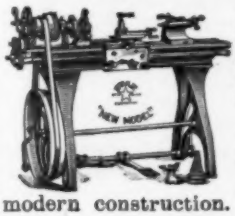
"STAR" FOOT AND POWER LATHES



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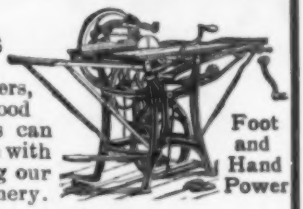

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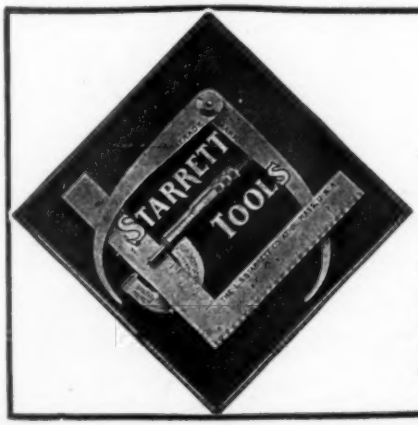

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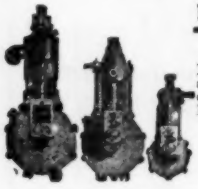

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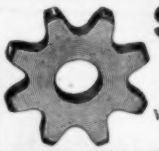

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KEEP ON KEEPIN' ON.

If the day looks kinder gloomy
  An' your chances kinder slim,
If the situation's puzzlin'
  An' the prospects awful grim,
An' perplexities keep pressin'
  Till all hope is nearly gone,
Jus' bristle up and grit your teeth,
  An' keep on keepin' on.

Fumin' never wins a fight,
  An' frettin' never pays;
There ain't no good in broodin' in
  These pessimistic ways;
Smile jus' kinder cheerfully
  When hope is nearly gone,
An' bristle up and grit your teeth,
  An' keep on keepin' on.

There ain't no use in growlin'
  An' grumblin' all the time,
When music's ringin' everywhere,
  An everything's a rhyme;
Jus' keep on smilin' cheerfully,
  If hope is nearly gone,
An' bristle up and grit your teeth,
  An' keep on keepin' on.
—New Orleans Times-Democrat.

This is going the rounds of Wall street. A broker from the financial vortex sought admission at the pearly gates. "Who are you?" said St. Peter. "I am a Wall street broker." "What have you done that entitles you to admission?" "Well, I saw a decrepit woman in Broadway the other day and gave her two cents." "Gabriel, is that on the records?" "Yes, St. Peter, it's marked to his credit." "What else have you done?" "Well, I crossed the Brooklyn bridge the other night and met a newsboy half frozen to death and gave him one cent." "Gabriel, is that on the records?" "Yes, St. Peter." "What else have you done?" "Well, I can't recollect anything else just now." "Gabriel, what do you think we ought to do with this fellow?" "Oh, give him back his three cents and tell him to go to hell."

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MAGAZINE FOR PATTERNMAKERS.

The Patternmaker is the appropriate name of a new magazine for that craft, and the first number is both handsome and interesting. It is published by the Iron and Steel Press Co., Cleveland, which also issues the Foundry.

GOOD INVESTMENTS

I have recently been selling the stock of two oil companies—**The People's Union Oil Company and the Illinois-Colorado Oil, Gas and Coal Company**—which have been placed on a dividend-paying basis and in less time than it takes the averrge man to think the situation over. : : : : : : : : : :

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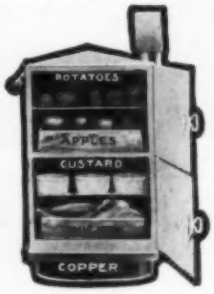

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11. **Saves 50 per cent in labor.**
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A TELEPHONE TRAGEDY.

The man stood at the telephone
And howled to raise the dead;
The Fire Fiend even shuddered at
The awful things he said.

He jabbed the trumpet in his ear
And with a gasping groan
He shrieked a prayer for mercy through
The soulless telephone.

"Give me the fire department—quick!"
He cried, "Oh haste, I pray!"
Eftsoon came back a languid voice:
"What number did you say?"

The man he danced a frenzied jig
And shouted it once more;
Around he heard with sore affright
The conflagration roar.

"Hey, Central!" shrieked he then at last,
"My whiskers are on fire!
Get busy, ere my dwelling place
Become my funeral pyre!"

All agonized he waited on,
To swoon with sorrow when
The yawning spirit voice came back
"Line's busy; call again."

* * * *

They found his charred remains beneath
The blackened brick and stone;
And still into his ear was jammed
The party telephone.

—Sunset Magazine.

POWDER USED AFTER FIFTY YEARS.

W. A. Clark, of Potsdam, N. Y., writes: "I have in my possession some powder that was bought about 50 years ago by my uncle and grandfather. They owned two rifles and did a lot of shooting. They stored their powder in a large stone heap on my father's farm. Uncle took to fever and died; grandfather never shot much and died not long afterward; my father was no gunner, so the powder, or a portion of it, was left unmolested. About 15 years ago I went and dug it up. There was a large flat stone over the box and about two dozen quarter-pound cans—round cans, I think—with an Indian's picture on each one. They were badly rusted. I picked the rusty cans from around the caked powder, broke it up and sifted out the dust, leaving the powder looking quite natural but for some red grains that showed the rust. I saved four pounds. I never tried it until last fall when I loaded a number of shells with it and some powder bought recently. The old powder shot fully as strong as the new.

HINTS TO INVENTORS.

The French government has offered three prizes for the best "reckoner" to be used in measuring alcohol on its production. The first prize is of 5,000 francs ($965); the second 3,000 francs ($579), and the third 2,000 francs ($386). The contest is open to all inventors in America. Competitors must give notice before Dec. 1, 1904. The internal revenue tax levied upon alcohol in France is calculated upon the volume of pure alcohol contained in a liquid at a temperature of 15 degrees. It is therefore desired to get a "reckoner" or "compteur," as the French call it, that will determine with certainty this degree as the liquid comes from the distilling apparatus.

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How do we know it is a *certain cure?* We know it because most distinguished *medical* men say so; because former *sufferers* say so; because *all who have tried it* say so.

A pure, delightful, wholesome *remedy.* A remedy not for a day nor a year. It affords a *permanent cure.* And the trouble *never recurs.*

And it is *an unfailing cure.* Thousands of thousands tell of its success. No one hints of a failure.

This is distinctively *the age of medicine.* This Wine is our contribution, and represents a *lifetime of study.* If most malignant diseases are curable, we believe that the above must be. The result shows that we were right.

"A bottle free!" you say. "How can you afford it? One bottle may cure me."

So it may, and so it will, unless your case is chronic. But, if you will not need to *buy* from us, your friends will, and we shall not make these gifts forever.

If your case is chronic the use of the first bottle will convince you that chronic ailments must yield to this remedy. It cures the diseases named, at *any and every stage.*

It is a natural remedy and so simple that others may soon learn its nature. They are making strenuous efforts to learn it and perhaps will. Meanwhile let us enjoy the triumph that they themselves have awarded to us.

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Fred Hoole, Hillsboro, Ill.: "I think Drake's Palmetto Wine is the best thing to cure *Constipation* I have ever found."

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Mrs. E. M. Marston, Lakewood, N. J.: "It acts on the liver the best any medicine I ever took."

Emma Ransdell, Turner Station, Ky.: "The only medicine that has ever helped my *kidney* trouble."

Fayette Smith, Wisconsin Vets. Home: "Surpasses anything. My *rheumatism* is fast abating."

We have such letters by the thousands. We have no record of a single failure. Are we over-confident when we say that Drake's Palmetto Wine Compound *will effect a cure in every case?*

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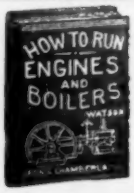

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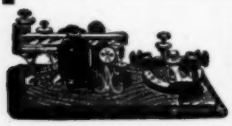

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I WANTER GO.

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I git a restless fidgeting,
A hankering to go
Away somewhere
An' I don't care,
Jest so
It's go.

I half b'lieve there's Injun nature
In every kind of mortal creature,
Which, when the sap do flow,
Will hustle men
Somehow agen,
Yer know,
To go.

For when the pussy-willows fly
Their yaller banners, somehow I
Jest but one thing can know—
It's really spring;
The proper thing
I know
Is "go."

The bluebird sez, "It's time ter move;
Jest 'cross the hill is waitin' love."
'Tis silly-like, I know,
But then, behind
We're sure to find
It slow
An' go!

A RABBIT CANNERY.

A rabbit cannery is the very latest American enterprise. Rabbits are the most prolific of all meat producing animals, and the cost of the "live stock" will be comparatively insignificant. E. S. Sylvester, of Echo Mountain, Oregon, is to be at the head of this new industry. He expects to can rabbits by the thousands, and from their meat he will produce "chicken" tamales, all kinds of canned chicken products, "lobster" salad, and many kinds of famous "French" soups. The rabbit meat has been found to make the finest kind of tamales, and the products are being shipped by the wholesale to New Mexico and California.

A new device to prevent the escape of insane patients consists of a simple electric contrivance placed under the rug by the bedside. As soon as any one steps on the rug an electric current is closed and a bell rings wherever desired.

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PATENT NOTES.

One frequently sees in the daily papers accounts of the enormous profits received from simple and novel inventions. Instances are given where the inventors obtain many thousands, and in some cases millions of dollars, from patents on useful devices or amusing toys which have come into general use. Again will be seen accounts of inventors who have impoverished themselves in trying to develop certain inventions, and have either been robbed of their ideas by unscrupulous adventurers or manufacturers, or have gone to their graves with the merit of their ideas unrecognized. Both pictures are undoubtedly accurate, but it is equally true that they represent rare incidents. The fact is, the average inventor neither makes nor loses a fortune on his invention. The country is full of inventors who have realized from a few hundred to a few thousand dollars from ideas that have come to them either by inspiration or from a little study. There are others who are in receipt of fine incomes from royalties on thir patented inventions. These inventors do not pose in the public eye, or appear in the public press, but it is largely through their efforts that the United States is to-day leader of the world in the production of ninety per cent of manufactured goods. Trace the origin of almost every successful business and you will find an invention as either the foundation or the key-stone.

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The labor unions in their efforts to control the output of labor have lost sight of one of the most effective means of controlling the situation and that is by owning patents on new inventions. As most inventors are now members of the labor organizations, it would be a simple matter for the latter to buy the patent rights on new inventions made by their members and either suppress the labor-saving device or machine, or grant licenses for the use of the invention on terms that would yield a profit to the union. Organization funds that are usually dissipated in supporting strikers and walking delegates could with great advantage be used in buying and controlling the inventions and patents of its members.

Necessity is the mother of invention. Well, money is usually the "old man" that must stand sponsor for "the kid," and it should be properly clothed in a patent before being sent out into the cold world.

Brains Not Needed.—Thermometers are not the only things which are graduated and get degrees without having brains.—Cornell Widow.

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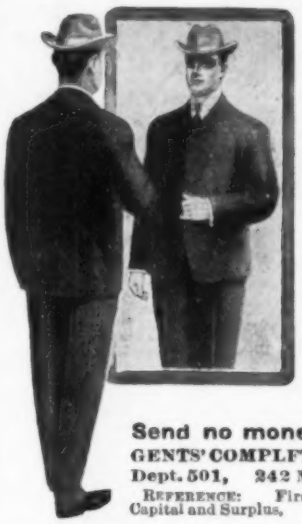

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Diamonds and gold never lose their value. They are always a good investment. From recent reports, the South African fields are giving out. Here is the opportunity to reap a great harvest.

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No better investment than diamonds. UNIMPEACHABLE TESTIMONY: "I have this day examined several hundred stones of your company and FIND THEM TO BE GENUINE DIAMONDS OF EXCELLENT QUALITY, ranging in weight from ten carats down." O. C. FARRINGTON, Curator of Field Museum, Chicago.

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The stock is registered. The officers and directors are men of the highest standing for shrewdness and integrity. No officer draws a salary until a dividend has been paid.

We believe that the stock of this company is not only safe, but also the best mining investment that is before the public. It is the only DIAMOND STOCK now on the American market. There will soon be more companies in the field, but as we had the pick we believe we have THE BEST that will be offered. WRITE TO-DAY.

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MORMONS FLEE TO CANADA

Claim the Dominion Grants Them Freedom of Worship the United States Denies.

It has remained for farmers of the United States to develop western Canada. Thousands of them are pouring into the Dominion every day. The figures show that 53,860 went from the United States during the last eight months. Among these emigrants are many who will remain loyal to the United States and many who are dissatisfied with our present form of government. Included in the latter list is an immense afflux of Mormons. Claiming that they are persecuted in this country and not permitted to enjoy the freedom the constitution of the Republic guarantees, they are swarming into Canada by the thousands. The Canadian government permits them to live according to their religious beliefs without molestation and a Canadian official says that they are doing more toward the development of the Northwest than any other class of people; that they are proving the hardest workers and most substantial settlers.

The World To-Day says: "Mormon settlements are moving en masse and almost in toto from different parts of Utah into Alberta, many trekking it over land through Idaho and Montana, while it was for some time no uncommon sight to see long strings of white-covered wagons being borne northward on the trains, the families living in box cars en route."

An association of land men that was recently formed at St. Paul, Minn., and that is aided by the Canadian government, is advertising Canadian resources all over the United States and is probably the principal cause of the great exodus into Canada.

WOMAN'S REST-ROOM.

"They talk about a woman's work,
As if it had a limit;
There's not a place in earth or heaven,
There's not a task to mankind given,
There's not a blessing or a woe,
There's not a whispered yes or no,
There's not a life or death, or birth,
That has a feather's weight of worth,
Without a woman in it."

RULE FOR COOLING SURFACE.

Following is a convenient rule for the amount of radiating surface required to cool one square inch of heated surface in the cylinders of gasoline engines:

With a velocity of 20 miles an hour, 38 square inches of radiating surface, such as is found in ordinary tubular radiators, are sufficient to cool one square inch of heated surface of the engine cylinder, with water delivered to the radiator at an approximate rate of two gallons a minute, the temperature of the air being that of an ordinary summer day. For each mile of speed less than 20, it is necessary to have an additional three square inches of cooling surface for each square inch of heated surface.

HOSPITAL CONSUMPTIVE CARS.

Hospital cars especially for the transportation of consumptives are to be placed in service by the Santa Fe railroad according to present plans. The Santa Fe reaches all the great resorts frequented by consumptives in Texas, New Mexico and California, and an immense amount of its traffic is of consumptive patients. The company believes the plan of having special consumptive cars would be more satisfactory than the present methods of disinfecting the regular sleepers and coaches.